PSYCHOLOGY

By HARRY L. HOLLINGWORTH

PSYCHOLOGY: ITS FACTS AND PRINCIPLES

MENTAL GROWTH AND DECLINE

THE PSYCHOLOGY OF THOUGHT

JUDGING HUMAN CHARACTER

THE PSYCHOLOGY OF FUNCTIONAL NEUROSES

ADVERTISING AND SELLING
Principles of Appeal and Response

VOCATIONAL PSYCHOLOGY

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A PREFACE FOR PSYCHOLOGISTS

This volume presents a systematic, descriptive account of mental phenomena and of psychological processes. The phenomena are subjective events; the processes are redintegrative sequences in nature. It is not easy to characterize the view here presented in terms of contemporary "isms." The book aspires to a straightforward description of certain aspects of nature, rather than to the defense of a prejudice. Although descriptive, the view is not that of "structuralism." It does not deal with a reputed dependent realm of "mental contents" or "conscious elements." Its psychology is dynamic, in that it deals with activities, processes, occurrences, rather than with static cross sections of mental life.

But neither is it "mere behaviorism," since it refuses to limit itself to the account of visible changes (movements). It shuns the visual bias of behaviorism; it insists that aches and pains receive the consideration to which their occurrence entitles them. Algesic patterns (pains), as well as visual patterns (animals), "behave." In contrast with behaviorism, the book offers a social report, based on all the evidence of all the available reporters; at least it advocates such a report. It is neither intimidated nor discouraged by the descriptive difficulties of any event in nature.

The point of view is not that of "associationism." Although there may be superficial resemblances, the contrast is striking. Mental activities, as here described, do involve association. But two important divergences from classical associationism are apparent throughout. It is not "mere ideas" that are connected, but primal events in nature. Some of these are ideas, but not the images nor psychic entities of historic tradition. Ideas are natural events, partial details of larger contexts, for which they function as equivalents in the course of

mental procession. And they are ideas only when they thus operate, as instigating cues. Ideas do not arouse their former totals. Instead, they act as adequate surrogates for these in the instigation of consequents which may or may not be ideas.

This relation of antecedent and consequent is really more congenial to the dynamic "reaction" psychology than to classic associationism. The descriptions presented, moreover, cover, without special pleading, the facts recently emphasized by the "form" psychology. It is believed that the account here given also escapes the several vices of the *"Gestalt"* philosophy of mind.

Since this is a textbook of psychology, it resolutely stands by its title. It has no chapters on neuro-anatomy, the physiology of the nervous or other systems of the animal body, or the structure of the sense organs. It finds plenty of honest psychological material at hand and cannot even grant space for many relevant suggestions concerning practical applications. These it recognizes, however, as part of the task of the science. They are left for collateral reading and incidental reference.

It is the writer's belief that the preoccupation of psychologists with hypothetical features of neurones, brain centers, synapses, and nerve tracts has impeded rather than advanced the science. When this book is used as a text, any significant correlations between mental and nervous structures or activities may be cited by the instructor or investigated by individuals or committees from the class.

It is sometimes maintained that "reference to the nervous system introduces into psychology just that unity and coherence which a strictly descriptive psychology cannot achieve." In reply, it is to be observed that biology did not go outside its own field to find its guiding principle (evolution); neither did physics import from foreign fields its ruling dogma (the conservation of energy). Why should not psychology also find its unity and coherence precisely within the field which it explores?

This is not to be construed as an objection to efforts to correlate the findings of the different sciences. When the

facts of neuro-physiology and of psychology are once well established, their correlation will be both imperative and interesting. But our present ignorance of whether, how, or why neurones are connected should not be substituted for an empirical description of the play of mental processes. We should look first to the account and relation of the psychological facts themselves, searching there for unity and coherence.

This we have found not only feasible, but even unavoidable in the course of psychological description. The unifying principle in mental affairs obtrudes, in whatever psychological activity one begins description. It is the principle of redintegrative sequence, at once the criterion, the mechanism, and the dynamics of mind. Unless one begin with the dualistic cleavages of theology and naïve philosophy, the road is clear for a systematic account of mental processes that is frankly descriptive, and therefore in the only scientific sense explanatory.

Within the continuum of nature we find redintegrative sequences, the potency of antecedent details, the gradual reduction of cues. Such sequences involve both "objective" and "subjective" events, as well as the many events occupying the intermediate region of the continuum of nature. Their study is the province of psychology, and it is to this enterprise that the present text is devoted.

H. L. H.

TO INSTRUCTOR AND STUDENT

The chapters of this text can be read and studied to best advantage in the order in which they are here presented. This is a psychological, rather than a formal, order. Each topic, in the main, develops out of the preceding chapters and in turn leads to those which follow, or demands them for its completion. But it is easy to exaggerate this feature, and the intelligent reader can no doubt profitably pursue a different order if this seems preferable.

Attention is called to the various appendices, in the back of the book, which should be at once discovered. They contain material suitable for collateral use in connection with class work in which this book is used as the chief or sole text. Appendix I contains a selection of classifications, which may be of interest in connection with several of the chapters, especially those on motivation, instinct, and emotion. Appendix II affords a series of projects or exercises for each of the chapters, which may be of use in class discussion. Appendix III gives for each chapter selected collateral references, briefly annotated in each case. These brief indications may serve as a useful guide for reference reading and for the study of points of view differing from that of the present text. Many of the references deal also with some of the practical applications of psychology.

Many psychologists wish to parallel the study of mental processes with a study of the nervous system and its activities. Some of the "neural diagrams" serve excellently as charts on which to map out the general scheme of activity. In other cases familiar "nervous conditions" are found to be significant determiners of the course of mental process, and the occurrence of subjective phenomena. The correlation between nervous activities and mental processes is so definite

and intimate (as for example in the case of the reflexes and the sensory qualities) that the consideration of both as biological aspects of an organism is often an instructive project.

For discussions of the structure and operation of the nervous mechanisms the reader is referred to standard textbooks on neurology, physiology, anatomy, or to other general psychological texts, many of which give considerable space to the structure and functions of the nervous system.

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CHAPTER I

MENTAL PROCESSES AS PSYCHOLOGICAL DATA

DEFINITION OF PSYCHOLOGY

Psychology is the science which concerns itself with mental processes and with subjective events. It is concerned with these two sets of items partly because of historical reasons and partly because, as we shall see later, there is an overlapping of the two fields. The time may come when psychology, as now constituted, will divide into two sciences, the one dealing with mental activities, the other with subjective events. Such tendencies already appear in common distinctions between behaviorism and introspectionism; functional and descriptive psychology; anthroponomy and psychology; the psychology of "the other one" and the "self-psychology."

Before considering the detailed subject matter and conclusions of this science, in the main body of this volume, it will be well to pay some attention to the features and items of this definition. We must know precisely what *mental processes* are. We must inquire particularly into the nature of *subjective events*. We must definitely indicate the general character of a science and especially note some of the fundamental principles and procedures involved in the science of psychology. We shall thereafter be in better position to present more or less systematic and typical chapters from the achievements of psychological investigation. First, then, what do we mean by mental processes?

THE PROCESSES OF NATURE

Science is a human activity or product which seeks to effect a complete and systematic description of nature. Nature comprises all those events that are encountered in life, or that can be observed and reported. All sciences begin with events and their reports. That there should be events, and that some events (reports) should bear testimony to others, is, of course, mysterious. But science is occupied neither with justifying the existence of nature nor with defending the activity of reporters.

Natural events not only occur; they also, in their course and change, exhibit varied patterns and sequences which in turn constitute events of a higher order of organization. Time, space, and order are not frames within which natural events happen. They are intrinsic features and pervasive constituents of the world itself.

Duration, shape, and diversity *occur* in the same immediate way as do color, brightness, and intensity. The so-called "true time," "real space," and "absolute number" are but convenient formulas. Either they are highly generalized descriptions or else conjectures, like the phlogiston of the ancients or the more modern ether. Space is a convenient term, generalizing the manifold observed spatial aspects of nature, as color designates the general class to which belong all the particular chromatic qualities encountered in the world. Time briefly recapitulates the observed durational and temporal successions encountered in the immediate flow of events.

The significant thing about nature, for science, is that it changes. Life "goes on"; events transpire. Natural occurrences exhibit a serial procession as well as immediate pattern and numerical order. In its more advanced stages science comes to be chiefly occupied with those complex events which we call spatial and temporal relations. If nature were unchanging, there would and could be no science, for science is itself an activity. Observable events, enduring unchanged, would require no description; they would always be available for exhibition. Much of science is, therefore, occupied with

the ways in which events proceed, with their transitions and sequences, and with the spatial and numerical as well as the qualitative aspect of such sequences.

CAUSE AND EFFECT RELATIONS

Among the earliest scientific terms of description were such words as "cause" and "effect." Events, in their sequence, were observed to display uniformities. Particular events of a given sort or class *follow upon* events of another class, and in turn *introduce* events of a third class. Changes in A involve changes in B; these entail changes in C, and so on. It was an error of the old psychology to suppose that things were *associated* only "in the mind." The fact is that *throughout nature* events are associated; associations in the mind are only special instances of this general fact.

Not only are events, in their temporal character, *casually* associated (as when thunder sometimes follows the lighting of a candle); they are also *causally* or customarily associated (a snowball always melts when thrown into the fire). Customary associations, when stripped to their essentials, are called *necessary*, or cause and effect relations. Some identifiable prior event (antecedent) is called the cause or stimulus of some inevitable or customary subsequent event (consequent) which is called the effect or response. A descriptive account is best given in terms of "antecedent" and "consequent." These terms emphasize the sequential character of the occurrence; in their abstractness they apply to all possible fields of observation; and they avoid the naïve assumptions of animism and of magic.

PHYSICAL PROCESSES

We mean by a process any series of connected changes. If, for the moment, and for the sake of clear exposition only, we consider simply the extremes of what is in nature a continuum, we may distinguish between physical and mental processes. We shall later need to abandon the sharp distinction when

we note the numerous intermediate stages between the two extremes; but with this preliminary warning our illustrations should not be misleading.

An iron rod, when thrust into the fire, at sunrise, on Monday, becomes red hot. The consequent follows upon a complex antecedent. But thereafter the poker will not glow merely because the sun rises, nor on Mondays, nor when thrusting movements are made with it, nor when deposited in the empty fireplace. Instead, only a particular feature of the original antecedent, contact with fire, will heat the iron rod. When thus heated, it glows no differently on Mondays than on any other occasions.

We are here in the presence of a physical process or sequence. The poker, we say, does not learn nor profit by experience. It shows no evidence of mind. By this we mean that the glow neither comes more *readily* for the *necessary* antecedent, nor does it come in response to signs, cues, fragments of the original antecedent context. A physical process or sequence is one in which a given *total* or *particular* antecedent (or one in its class) is required to instigate a given consequent (or one in its class).

MENTAL PROCESSES

Now, instead of the changes in a poker, consider the behavior of a fear. Suppose that, as a child, I once experienced a violent terror, when alone and attacked by a small spotted bulldog, in a narrow passageway, with only one exit, barred by a gate with a latch too high for me to reach. Thereafter, for a long time, fear comes upon me whenever a dog appears or when doors are closed or when I enter a narrow area such as a hall or tunnel. For years I note vague apprehensions or slight anxieties when left alone or when small animals are about. To the end of my life I loathe all spotted patterns and am strangely disquieted when such words as "bull" or "passage" or such objects as barred gates, high fences, or lofty spires are encountered.

We have here described a number of distinctly mental pro-

cesses or sequences. The fear originally ensued upon a complex antecedent and was a response to the total situation. Thereafter, however, almost any detail of this context arouses such a fear. That the fear evoked varies somewhat in character and degree with such factors as the particular detail presented, with lapse of time, with the number of instigating details, with the momentary context in which the detail occurs, is an interesting fact for further scientific account.

In the case of a mental process or sequence the original antecedent (or its very like) is not required to produce a given consequent (or its like). Instead, some detail or fragment is adequate to touch off a consequent of the type formerly evoked by a more complex antecedent. Of this antecedent the instigating fragment (or its like) was formerly but a part.

When the response to the detail is determined not by its past context alone, but also by current events occurring with it, we say we are dealing with healthy or sagacious mental processes. When the response is prepotently determined in terms of the past context and is incongruous with the present situation in which the detail occurs, we describe the activity as unbalanced or neurotic. When only present events are effective and there is little or no capacity for symbolism, that is, when past contexts have little to do with the nature of the response, we describe the process as dull or feeble-minded. In this case the type of sequence approaches the physical.

In a mental procession or sequence, then, learning occurs. Consequents happen in dependence upon past as well as present antecedents. Signs, cues, symbols, become potent to evoke consequents appropriate to larger antecedent contexts of which the signs were partial components. In a mental process or sequence a detail "*A*" (or one in the same class, as "a," or "*a*") instigates a consequent *XYZ* (or one in the same class, as $x'y'z'$ or xyz) by virtue of the previous participation of that detail (or one of its class) in the situation *ABC*, which formerly evoked the consequent *XYZ*.

Since the word "mental" is used so loosely and vaguely in ordinary speech, it is well to have a definite and technical

term by means of which to refer specifically to processes which follow this pattern. In this book the word "redintegrative" will commonly be used instead of the word "mental." By a mental process or a redintegrative sequence, then, we shall mean a series of changes in which a partial antecedent functions appropriately or adequately for a former antecedent of greater complexity. In later chapters such processes will be examined in great detail.

The psychological sciences are interested in such sequences as exhibit the redintegrative pattern and in such natural events as participate in them. Sequences of the nonredintegrative type are the immediate concern of the physical sciences. Since, as we shall later have occasion to emphasize, the distinction is not actually a sharp one, there is also occupation for various biological sciences, which thus bridge the artificially developed gap between psychology and physics.

A PSYCHOLOGICAL SITUATION

Very simple experiments serve to set the stage for long arrays of psychological queries concerning mental processes. The following example will instructively introduce many of the topics which are to follow. To each of five persons I give a slip of paper, bearing secret instructions—questions which each is to answer but not to reveal, except perhaps by writing on the slip of paper.

Then all stand before a brief-exposure apparatus in which is flashed, so that all may see, a card bearing the following relatively meaningless inscription:

On the slip of paper, each person is now to report "what appears" on the flash card. This card is shown but once and for only a fraction of a second. In the following table there is given for each person, first the instructions he secretly re-

ceived; then, in parallel column, what he says appeared on the flash card.

Preliminary Instructions Given to Each Person	*What Each Saw on the Flash Card*
1. In what various ways may a shoe be fastened?	button
2. What are the chief simple taste qualities?	bitter
3. What are the various positions in a ball game?	batter
4. What various things may be eaten on bread?	butter
5. Comparative and superlative of "good" and "bad"?	better

Now as far as the flash card is concerned, the same events occurred in the case of each person. Each was shown the inscription, which is not a word, although it has some letters and is in some ways shaped like a word. But not one of the observers reported this inscription in the form in which the experimenter drew it on the card. All of them reported a word, and this in itself is a significant fact. But no two of them reported the same word, a fact of equal interest.

The inscription, it would appear, is a mere "cue." It instigates the report which the observer writes on the slip. Just what will be reported depends not only on the nature of the cue, but also on the nature of the past experience of the individuals who see it. In part this experience is common to all; such marks as those of this inscription commonly stand for words which may be spoken and written. But the most recent experiences have been different. One has just been thinking of baseball, another of shoes, another of the sense of taste, and so on. What each observer reports is jointly determined by the presented cue and by the recent contexts in which words resembling this inscription have been dealt with.

Most of mental life is summed up in this experiment, brief as it was and simple. The inscription is a cue or symbol. It stands for other things, has meaning. This meaning is determined by past contexts—reading, in general, or thinking of particular things. Such meanings had first to be learned. The use of things once learned is memory. Each observer had to think or reason; the cue was a problem to be solved, a stimulus to be responded to. The report is a consequent of

this situation. Details of the inscription, partial features, belonged also to other words seen in the past. These details now function quite as if the whole word were there. Letters are seen which are not there; this is imagination. Marks there are overlooked; this is a matter of attention. One word only could be written, which required choice. Seeing the whole when only the part is given is perception. The feelings of curiosity, interest, doubt, might also be found in such a simple situation.

We have thus illustrated many features of a mental or redintegrative situation. A partial detail, presented on the card in a random context, functioned as the surrogate of more elaborate contexts of which it had formerly been a part. This, as we have seen, is the essential thing about mental processes. We could, indeed, find even in this simple experiment all those psychological features which we shall subsequently come to know as meaning, perception, motivation, learning, memory, association, habit, imagination, purpose, reasoning, feeling, decision, sensation.

But we must proceed slowly, and one aspect at a time will occupy us. It will, however, be useful to remember, in the case of each subsequent chapter, that its topic does not represent a unique and independent activity. All the features of mental activity to be described in this book may be found in or abstracted from this very simple act of reporting what is seen on a flash card. We shall seek, soon, for a more general acquaintance with mental or redintegrative processes, then pay special attention to particular aspects of such sequences.

FIELDS OF MENTAL PROCESS

Many things in nature seem capable of participating in or exhibiting these redintegrative or mental sequences. Fears, to which we have referred, but illustrate a large class of emotions which may engage in such patterns. Aches, pains, simple feelings, and memories do so, and even quite simple "sensory qualities," as in the case of the occurrence of mental images.

More complex processes of the mental sort are found in judgments, beliefs, preferences and choices, illusions, perceptual interpretations. Many of the movements of my own body, as in acts of skill and other habit activities, afford neat examples. Dreams provide one of the clearest fields for the observation of such patterns. Perhaps most conspicuous of all, because of their complexity and frequency, are the redintegrative activities of that great group of visual-tactile objects which we call "other animals." And we are led to consider also that those numerous conjectured or reported events which we call the aches, pains, and so on, of other people, conform to the same pattern.

One large division of psychology, as it has historically developed, has come to concern itself exclusively with the redintegrative and other activities of those interesting events called animals. The "anthroponomists" or "behaviorists" engaged in such studies have sometimes become so engrossed in their subject matter as to deny that any other kind of interest is legitimate psychology. Indeed they have, in extreme instances, not only ignored the fact that other types of natural events exhibit this redintegrative pattern but have been led into the strange delusion that none but visual-tactile events occur.

We may now return to our original definition of psychology as the science occupied with the study of mental processes and subjective events. We have described mental processes as redintegrative sequences, in which a detail is substituted for a larger antecedent context in the instigation of consequents. We have next to inquire into that other field of psychological interest, namely, the nature of subjective events.[1]

[1] Appendix II contains series of projects, questions, and exercises for each chapter. Appendix III gives selected and briefly annotated references on supplementary and collateral topics. It will be instructive if some or all of these are reported and compared with the present text, chapter by chapter. In some instances the chief significance of the present discussion arises from its contrast with prevailing conceptions.

CHAPTER II

THE NATURE OF SUBJECTIVE EVENTS

NATURAL EVENTS

A natural event may be defined as any occurrence that can be noted and reported. Thus a color, a toothache, a star, a distant mountain, falling snow, a new species of butterfly, the similarity of two tones, the shape of a crystal, the temporal sequence of two odors, the importance of being in earnest, the joy of discovery, the devotion of a dog to its master, the harmony of an orchestration, the movement of the planets, the incongruity of two propositions—all these are natural events, encountered by human beings in the course of life. They are found in nature. "The world" or "the universe" consists of that joint account which we give of such occurrences.

Some events strike us as simple and relatively elementary. We often call these *qualities*, as in the case of a color or a pain; or *relations*, as in the case of a difference, a succession, an excess.

Some events appear in series, either continuous or discontinuous, and with such uniformities that we name the *series* also, as a fire, a whirlwind, or dizziness. Events in themselves more or less disparate may manifest organization and pattern, and we call such configurations *objects*, as in the case of a house or a rainbow.

Various occurrences, of a similar but discriminable character, appearing on different occasions, we call *classes*, as capital letters, clams, novels. Thus, "the word man" is a class of particular inscriptions (MAN, man, and so on) rather than a persisting identity. The same may be said of one's child, who, constantly changing in locus, behavior, and appearance,

nevertheless constitutes a certain namable and highly elaborate class of events known as "my son."

There are also *processes*, activities, episodes, in which events, however complex, occur in observable sequence, as war, walking, evolution. And sets of events constellated with certain mutual relations and interrelations comprise what we name *situations* and circumstances.

Events, that is to say, need not be noted in isolation. Qualities and relations may appear simple and unanalyzable, but series, objects, classes, processes, and situations are complex; they may involve many discriminable factors in modes of sequence and configuration. We may conveniently use the term "events" for any and all such occurrences without regard to the question of complexity. Complex events are in turn analyzed into simpler events.

We have not sought in these illustrations to give an exhaustive enumeration of the modes of organization found in nature. Instead we have given only an array sufficient to indicate the free and neutral way in which the word "event" is to be used in this book. A throbbing pain, an unchanging odor, are events, even as are more complicated episodes, such as the growth of a plant or the rise and fall of an empire.

SUBJECTIVE AND OBJECTIVE EVENTS

Some words are dangerous because of the diverse uses to which they are put. Thus "the pains" with which a father educates his son may refer either to the pangs of the one or to the prudence of the other. The word "subjective" is similarly handicapped. We found the same difficulty with the term "mental," and in that case determined to substitute for it the rather formidable but specific term "redintegrative." It seems best to retain the word "subjective," adopting a specific definition of it. The word "subjective" is in common use in at least the following ways:

(*a*) Subjective affairs: those occurring not in the physical world but in another entirely separate realm, the world of consciousness.

(*b*) Subjective affairs: those on which people do not agree, the verdicts of different reporters often being biased by their personal idiosyncrasies or histories.

(*c*) Subjective affairs: those not accessible to general inspection or to mechanical record, hence capable of scrutiny by but one or at most a few witnesses.

(*d*) Subjective affairs: those intimately related to the activities and circumstances of the speaker or writer, as distinguished from the general or social welfare.

As different as these usages appear, there is one element present in them all, this feature being the discrepancy of report. When I find a toothache in my world and report the presence of this pain in nature, other reporters are unable to observe it. Our reports are discordant. When that scintillating and distressing optical event known as a migraine figure appears in my visual field and I ask my friends if they do not see it on the wall or with closed eyes, nearly all look surprised and report no such occurrence. An occasional friend admits that he sees such a figure, but whereas I observe that the figure unfailingly moves from left to right as it unfolds, he insists that it moves, instead, from right to left; our reports are discordant. None of my friends reports the toothache, and although one reports migraine figure, it is clearly not "the same" figure that I encounter.

Again, I ask a group of children whether they have a love for their teacher. Most of them admit it and describe it in reasonably consistent terms. But there are dissenting reports. Several insist that they find no such affection in their hearts; instead they may report a bitter hatred or a cold indifference. But when I ask whether the teacher is in the front or the back of the room, whether he is blind, or tall, or more than ten years old, the verdict is unanimous. Love and hate are subjective; height and age are objective.

When we investigate the presence of an ache, an affection, and a person; when we invite descriptions of a migraine figure, an emotion, and an animal, we find various degrees of consistency in the available reports. It is easy to arrange a set of topics which would disclose the continuous transition from

reports with which no one else agrees to those to which practically every one assents.

"Common sense" has fixed on the two extremes of such a series, and has used "objective" for events consistently reported, and "subjective" when one reporter finds the rest disagreeing with him. We have no definite terms provided for the intermediate degrees of statistical agreement, just as we have no precise words for the intermediate ranges of such continuous series as those indicated by tall–short, sick–well, sane–insane, heaven–hell.

Events unanimously reported, moreover, are by common sense supposed either to *be* real events, occurring in a world of fact, or else they are supposed to *reveal*, or intend, or point to certain genuine occurrences in an unobserved but enduring world of physical reality. Events reported adversely to the consensus of opinion, are supposed instead to be only "psychic states," occurring in a world of "consciousness."

THE CONTINUUM OF NATURE

There are thus two popular tendencies. The one leads to the sharp separation of objective (consistently reported) and subjective (inconsistently reported) events, the former constituting a physical world, the latter comprising a mere stream of consciousness. The other tendency leads to the conjecture of supernatural existences, to the features of which *some* actual observed events "correspond" or "point" ("imply" is the word used by the logician), while other natural events make no such revelation of supernatural reality.

According to the first tendency, the uniformly reported items *constitute* the objective or physical world, the variable items comprise the subjective or psychic world of conscious states. According to the second attitude, all directly observable and reportable events are mere "conscious appearances." Behind the consistent ones are postulated or inferred or implied "realities"; the inconsistent ones are meaningless happenings in the conscious stream where they occur.

If either of these popular tendencies be followed, there arises

a sharp distinction between the world of conscious events and the world of physical stimuli and mechanisms. It must be noted now that this sharp distinction arises from the *neglect* of that intermediate crowd of events which are reported with only intermediate uniformity. But since there are continuous gradations of consistency of report, are there not, therefore, also events crowding into the gulf between "conscious states" and "physical realities," and completely filling that gulf?

Are there not ambiguous events that are neither clearly physical nor clearly psychic?—or, if it be preferred, events intermediate between those which clearly transcend themselves and "point to the beyond," and those which fail to do so? Is the *sequence* of two tones a conscious state or a physical time relation? Is the *shape* of the rainbow either just a psychic or just an actual fact? Is the *distance* between two words on a page a subjective or an objective distance, or both, or somewhere in between? And what of the *structure* of a melody, the *harmony* of two tones, the *beauty* of a flower, the *resistance* which objects offer to our progress?

Are diphtheria and rheumatism *actual diseases* or only constellations of *conscious states?* And for that matter, are our so-called sensory experiences, the visual patterns, the colors, the after images, the sounds, pressures, temperatures, odors, pains, and the dream pictures, all sharply classifiable as either equally subjective or equally objective, equally psychic or equally physical? If events reported by but one reveal no hidden and corresponding reality, while those reported by the many imply abiding realities corresponding to them, what then of the events reported not by one only, nor by all, but by the few?

COMMON SENSE AND PHILOSOPHY

It should be observed that we are not at this point considering the supposed "nervous basis" of reported events, the brain processes with which physiology is concerned. All "experiences" are commonly said to have their "neural correlates." But some are conjectured to reveal or point to *further* physical facts, in addition to involving or depending

on a "brain event." Thus that visual event known as a star is supposed not only to depend on retinal and brain activities, but also to correspond to a "real star." This real star, to which the visual star points, is conceived to be the source of energy which, as it impinges upon the sense organs, sets going the "brain events" of the observer.

But the migraine figure, although it also presumably depends on retinal or brain activities, is commonly supposed to reveal no physical object corresponding to it. It is supposed to exist only "in the mind," along with other "mere conscious states," such as memories, images, feelings, hopes, aches, pains, and the like. Common sense either sees no absurdity in such a result, or has no time to bother about it.

The various practices we have been considering are also reënforced by other habits of "common sense." Thus we may consider, not different reporters, but different reports of the same observer. A visual event may be attended by or correlated with an odor, a sound, or especially a pressure. Common sense assumes that such a complex of qualities implies some underlying "physical object," which is thereupon inferred. Pains and migraine figures may be only conscious episodes, but "tangible" affairs point coercively to something beyond.

If the testimony of vision be not supported by or correlated with events of other kinds, it is readily concluded that the visual event is only "in the mind." This tends to be true also of events of other kinds. Thus a competent workman once assured me that air is not "a real thing," since though he could *feel* it cooling his cheek he could not *see* it nor *grasp* it. In this way a single observer checks up his own observations. Events well correlated with others imply "actual objects" *behind* them, or perhaps constitute such objects. Those not so correlated are only "conscious experiences."

From these considerations it appears that the distinction between subjective "psychic events" and objective "actual events" is arrived at only by a sharp dichotomy (dual division) which overlooks the large region of intermediate occurrences. In the same way the sharp classifications of people as sick or well, abnormal or normal, overlook the great

majority of the population, who are neither the one nor the other, but are merely "ailing."

Hence, whether the "actual" be supposed to be immediately presented, in the form of observed events, or to be a physical system implied by the coherent flow of such events, the sharp distinction between subjective and objective, psychic and physical, appearance and reality, sensation and stimulus, is unjustified. The world of natural events is a continuum, and there are all degrees of consistency of report, all degrees of closeness of correlation.

Traditionally, psychology has been supposed to occupy itself with the description of "conscious occurrences." Since some of them were supposed to "point beyond themselves," psychology undertook to describe the events, epistemology to deal with the pointing and physics to handle the actualities pointed at. The ambiguity involved in the pointing, and the indirectness with which realities must be approached which are by definition unobservable, have occasioned on the one hand the confusions of philosophy and on the other the precarious instability of theoretical physics.

THE PLACE OF PSYCHOLOGY

The fact remains that one or a few people may report events inaccessible to others (aches, pains, migraine figures). Moreover, even when reports show many points of agreement, they often differ in various details. Thus if differently located observers report the appearance of a table, by describing or sketching it, their reports vary according to their "points of view." We may harmonize these discrepant reports by assuming a "real table," with such properties and correlates that it will "appear differently" from different places. The inferred actual table is thus not a natural event, it is a supernatural construct, a fiction, hypothesis, necessary implicate, physical object, and so on. It is a construct or formula which, if adopted, serves to bring order and consistency to discrepant reports. Psychology occupies itself with the initially discordant events; physics is concerned with the conjectured real

table and its correlation with other conjectured realities and formulas.

It may be remarked that conjectures are sometimes verified, that is, natural events may be observed which accord with the description of the conjectured construct. The conjectured object turns out not to have been a supernatural at all, but a natural event not yet encountered. But more often, in the history of science, conjectures once generally "accepted" are in turn "abandoned" in favor of other conjectures.

We have thus, after this long but necessary exposition, arrived at the conclusion that *some of the data* of psychology are constituted by those natural events which are inconsistently reported, or are reported by but one or a few individuals —events, that is, which are subjective.

In such an enterprise it is advantageous for the psychologist first to study those subjective events to which he himself has access. This gives him at least a tentative basis for understanding and interpreting the subjective events reported by others. Of course, there is occasion for great care in such interpretation. An adult, for example, in terms of his own experience, may wrongly interpret the subjective events reported by children or inferred from their conduct. But such dangers are not insurmountable, as the following example will indicate:

A blind man could, with some difficulty, conduct studies of color and color relations and combinations, provided he had the assistance of a color-reporting observer. Even though he would be denied first-hand knowledge of color qualities, he could, by merely listening to the observer, formulate laws of color mixture, contrast, choose complementary color pairs, and pass judgments on color harmonies. By observing the relations of the items of the observer's reports, and accepting these items as surrogates for colors not open to his inspection, he could learn much concerning the relations and correlations of color events. Helen Keller, for example, although both blind and deaf, can talk intelligently about both colors and sounds.

Much of science is based on such inference. Relations found

among observable events are taken as signs of relations among unobservables. All that is required is adequate correlation between events and the items of the report. Neither the latter nor their relations need be *copies* of the events inferred from them. We shall see, indeed, that this fact is what makes thought itself possible: symbols and their relations function for things and their relations.

THE CONCEPT OF CONSCIOUSNESS

Events reported by another but inaccessible to me are often called his "consciousness." For me such events are not immediate data but conjectures inferred on the basis of his testimony or conduct. But, although inferred, they are taken to be events of the same kind as those composing the natural world to which I have access, and in which his testimony or conduct occurs. In turn, when studying the events accessible only to myself, I am studying what he might term "my consciousness." When either of us studies events accessible to many (consistently reported) we are supposed to be studying (either directly or indirectly, according to different brands of philosophy) the objective or "external" world. And since natural events as reported manifest all degrees of "privacy" or consistency, there is no sharp division possible between the psychological and the physical sciences so far as this aspect of their work is concerned.

Events reported by another are always inferences on my part, since the other person is, for me, a complex event in the immediate natural world. When his reports lead me to infer events coincident or consistent with my own observations, either of two things commonly happens, as follows: Either (*a*) there is commonly assumed one "object," which my event *is*, and to which his *points;* or else (*b*) the event present to me and that to which his report points are supposed in turn to point to a further real and hence inferred fact.

In the first case there are my natural objects and his "conscious states." In the second case there are my natural events, his "conscious events" (for me, inferred natural events, on the

basis of his testimony), and the further conjectured realities back of both. The general case, be it remembered, is that in which my observed events accord with his reported events.

In this general case then there is but one consciousness involved, namely, that of my neighbor, as studied by me, and it is by definition a conjectured set of events resembling my natural objects. In this situation there is no "my consciousness," since whatever my consciousness be, it is something occurring in that natural world which I report. And if my natural world is also called my consciousness, there is nothing else left but conjecture. This was the point of view of that strange philosophical cripple called "subjective idealism." This confused doctrine is far from the account here acceptable. We insist that if my consciousness is a genuine occurrence, it must happen in that same world in which other things, such as mountains, neighbors, wars, and shipwrecks happen. And since my consciousness must occur *in* that world, it cannot be coincident with nor exhaust it.

In alternative (*b*) my natural world and the conjectured world of my neighbor's reports are supposed only to be symbols or revelations of a real world. Here a certain choice is permitted. If they are *revelations,* there is no need for such a word as consciousness, since what appears is the one reality studied by all the sciences. But if these events (immediate and inferred) be considered only as *symbols,* and hence as "conscious states," all sciences must deal exclusively with consciousness, since that is all that immediately appears, and again we should have no use for such a word.

But we have also to consider another general situation. This is the situation in which my neighbor's reports lead me to conjectured events neither coincident nor consistent with my own. Such inconsistent events (immediate and conjectured) might be called "my consciousness" and "his consciousness" respectively. Consistent events, as we have just seen, are taken instead to be, in my case, the world of fact; while the inferred events are not part of the natural world but are what I call his consciousness, because inaccessible to me.

So that, from all the possible situations, there appear but

two places for such a word as consciousness. These are: (*a*) the events accessible only to my neighbors, and (*b*) those of my immediate natural events which are inconsistent with these or with other events of my own. Hence we arrive at the use of the word consciousness for only the inconsistently reported events in nature. So far, then, as psychology can be said to deal with consciousness or with subjective events, this can mean only that it is occupied with events discrepantly reported or obscurely correlated.

Events are discrepantly reported because (assuming no intent to deceive) each event, as described, is encountered by but one or a few reporters. It is in this sense that they may be called "subjective," and that psychology is, in part, concerned with subjective occurrences. *Part of its data* comprises natural events which, since accessible to but one or a minority of observers, are inconsistently reported. An event is inconsistent when it is observed by one reporter but denied by others, that is, is differently reported by different observers.

In this book we shall continue to use the word "subjective" to refer to events inconsistently reported or accessible to but one or a few reporters. For the word "consciousness" we shall have but little if any use. When used, it will refer to events that not only occur but are reported. The mere occurrence of an event, as a pain, an image, a rainbow, or an earthquake, is simply a fact in nature. The *consciousness* of it we shall see to consist in some *report* of it. An event will be conscious when it evokes another event which is a name, synonym, sign, or other symbol of identification. The justification of this use of the term must be left to later chapters. But the reader should make particular note of the fact that we do not start with a realm of "conscious stuff," contrasted with a world of "material stuff."

Consciousness is not a new substance, appearing at some point in the evolution of a system which to begin with is exclusively matter. Consciousness is "made" of the same stuff that comprises the rest of nature. Consciousness is a mode of sequence, a way in which natural events go on. It is what happens when one event points to another. The nature

of the pointing will be a matter for concern in a later chapter. But the fact that consciousness is not the name of a substance nor of a closed system does not prevent its having occurred first at some historical point in the evolution of nature, if this should be found on other grounds apparent. Modes of sequence have their history as truly as do substances.

SUMMARY

After these somewhat abstruse considerations a summary of the main points of this chapter is in order. The natural world, then, consists of events accessible to reporters. The important point is that by nature we mean neither a private stream of psychic episodes, nor a fancied structure behind observable occurrences. The world of nature is that flow of events comprising our living and being, and immediately encountered by one or another reporter. It is that neutral continuum of occurrences, ranging from private to public, through intermediate degrees of consistency, and *within which* we make such distinctions as subjective and objective, mental and physical, just and unjust.

The situation may be stated briefly, but unfortunately only by words which, because of their history, are likely to be misleading. Let us try. We start with *experience*. But this is not to be "subjectively" construed. Experience is the matter-of-fact, phenomenal stuff of nature.

Some facts manifest purely mechanical, nonredintegrative sequence. We call them the inorganic, the physical world. Others richly exhibit the redintegrative pattern, as described in the preceding chapter. We call these psychological, the mental realm. Still others curiously combine the two modes of sequence. We call them the organic, or sometimes, with confessed ambiguity, the psycho-physical.

The continuum of nature, however, tends to become a joint or public world, in which testimony of all available reporters is pooled and supplemented by conjecture. This results from the fact that signs may be substituted for larger contexts of which they have been portions. Words are accepted as evi-

dence of things, and coöperative or social description is thus rendered possible in the form of science. Psychology, in its present stage of development, has a double task. It is charged with the description of subjective events, with their varying degrees of privacy, and with the investigation of mental processes, with their subtle modes of instigation.

There is no necessary relation between mental processes and subjective events, nor are the two fields in any way coördinate. They represent relatively independent classifications of natural events. There is, however, a considerable overlapping of the two fields, which may occasion confusion unless this fact is clearly noted.

Mental processes may be subjective, as in a daydream or in anger at a remembered act; or they may be objective, as when an animal is observed to acquire an act of skill; or a given mental process may involve both objective and subjective features, in any degree or combination.

Subjective events may be intimately involved in mental processes, as in imagination, reflection, planning; or they may not, as in the mere "having" of aches, pains, feelings, and other simple qualities. "Mental," "redintegrative," refer to the pattern in which events occur, regardless of their subjective or objective status. "Subjective," "objective," refer merely to the consistency or privacy with which events are reported without regard to the patterns exhibited in their sequence.

CHAPTER III

PSYCHOLOGY AS A SCIENCE

SCIENCE AND PRACTICE

It is apparent that psychologists are not the only ones occupied with mental processes and subjective events. So also are poet and priest, novelist and judge, teacher, parent, and lover. The success of hunter, cowboy, detective, and salesman depends in part on their understanding of the mental activities of the creatures with whom they deal. Dentist, surgeon, diagnostician, and tailor guide their conduct in part by the subjective aches, pains, and comforts of their clients. Each of us is absorbed in an "inner world" of imagery, feeling, and impulse which others can know only as we betray it through speech, expression, or conduct. How do these practical contacts with psychological affairs differ from the activities of science?

The essential difference is that science is primarily a descriptive enterprise. Its criterion is fidelity to nature as a whole rather than the satisfaction of particular personal interests. Science is, in general, an effort to effect a complete and systematic description of nature.

All sciences begin with natural events and their reports—astronomy and mathematics, physics and chemistry, no more nor less than psychology and sociology. Science is occupied with the discovery, description, and correlation of noted and reported events. It also engages in speculation, inference, hypothesis, conjecture, devises convenient constructs or fictions which, it is hoped, may further subsequent description and organize accounts already available.

Scientists, as human beings, may also engage in such applications of their information as may influence the course of

future events, whether for scientific or for practical ends. They may also engage in various other characteristic human activities—form societies, raise funds, celebrate birthdays, wage war, and participate in all the varied concerns of life. But their strictly scientific efforts consist in the endeavor to observe accurately, to record and correlate faithfully, those events which in their totality comprise nature. The natural world consists of all those events accessible to observers, or validly inferred by them on the basis of observed events (including the testimony of other reporters).

OBSERVATION

The tasks of science, therefore, comprise the following steps: observation, report, conjecture, and application. Observation implies that events may either be, on the one hand, endured, enjoyed, suffered; or, on the other hand, they may be carefully regarded. It implies that there are events or phenomena which may occur or be encountered. To *observe* them rather than merely to *endure* them may involve special techniques of inspection.

Events may merely be scrutinized as they chance to occur, as the astronomer and physician observe many of their data. Or they may be diligently sought for—as the geologist digs for fossils, the historian for records. Or they may be deliberately produced by experiment, under carefully controlled conditions, as when the chemist produces new synthetic products, the toxicologist administers poisons to animals, or the geneticist combines selected types of plant or animal life.

Inspection, exploration, and experiment are, therefore, ways of observing the course of natural events. All of these methods call for more rigorous modes of examination than the casual regard which the unscientific man bestows upon the episodes of life. Psychology as a science employs all three of these modes of observation.

Thus a psychologist, studying fears, does more than merely suffer the terrors that inevitably fall to his lot. When such chance fears occur, he attentively regards them, notes their

character and variety and the course they run. But he also endeavors to frequent frightful places or encourages others to do so, thus increasing the occasions for attentive observation. Finally, he may designedly provide fear-provoking conditions, with known and controlled variables, and may submit himself or others to these situations, under circumstances that can be carefully prearranged. Thus he inspects, explores, and experiments, observing a selected class of natural events, and this is the first step in psychology, as in any science.

REPORT

But observations must be recorded, classified, and correlated, to have scientific value. The scientist seeks to describe, explain, and utilize the course of natural events. Not only for the sake of his own work, but also that he may coöperate with other observers, records must be devised. For his own work such reports are needed, because of the unreliability of memory. For the sake of others, reports are conveniently made in terms of conventional symbols, such as speech, writing, photography, diagrams, or mathematical formulas.

Moreover, report involves more than the symbolic record of isolated events. These must be compared, their mutual relationships discovered, and correlated with other events and systems of events. The geologist may collect and preserve many of the classes of events he observes—the bits of stone, the fossil remains. The astronomer, whose events are more transient, must secure photographs and diagrams of the transits, eclipses, and comets. The physician is driven still further, to elaborate verbal reports of behavior and symptoms, which may not only be transient but extremely variable. The psychologist also must resort to the greatest degree of symbolic record, for the events he observes may in many cases be evanescent, instable, wholly irrecoverable, and not reproducible. Thus one's fears do not come and go in the relatively unrelated way in which fossils occur. The second fear may be profoundly altered because of the course and outcome of the first fright.

The data of the biological sciences are more variable than those of mechanics and physics and may call for special and elaborate modes of report and record as well as for special training and aids in observation. Psychological data, as we have seen, are still more variable, and the variety of necessary aids is great. There may be need of special observational skill, of unique apparatus, of delicate experimental technique, of oft-repeated records, and of elaborate and highly abstract modes of verbal, mathematical, and statistical analysis not required in all sciences.

Thus the fears of different observers vary enormously in quality and degree and are complexly related to such various factors as occasion, situation, age, previous experience, bodily condition, hopes and expectations, memories and affections, as well as to previous fears. Fears may be more easily produced than fossils, but they are much more difficult of adequate report and record, classification, correlation, and comparison.

A further aspect of scientific report and record is of special significance for psychology. Some events, such as fossils, are of a nature that leads to their consistent report by different observers. They may loosely be said to be open to general inspection. For that reason, as we have already noted, they are often called objective events and assigned a stable and causal status in the "public world." Either they are supposed to *be* entities in a "physical realm," or they are supposed to "correspond" or otherwise to point to inferred "physical realities."

Other events, such as a toothache, are accessible to but one observer, the one who "has" them. Two geologists, it may be said, may encounter a given fossil; but only one psychologist can experience a particular pain. Fossils are objective and feelings are subjective; but since both fossils and feelings occur in nature, science must concern itself impartially with both.

Events accessible to but one reporter have been curiously and sometimes suspiciously regarded. Their inspection has been given the name "introspection," on the assumption that

such events occur only *in* the reporter. Discrepant reports, by different observers, who encounter not "the same" pain, but pains presumably in the same class, have led to the distrust of all reports based on the testimony of single witnesses. If different geologists regarded not "the same" fossil, but different fossils, presumably in the same class, some thoughtless judges might even be led to deny that such things as fossils exist.

There is nothing unique about the act of introspection, except the occasional subtlety and evanescence of the items observed. Observation, inspection, does not change in character merely because many or few people engage in it. But it is true that some events are less liable than others to public, that is, to consistent report, and that psychology has a special interest in them.

Many of the data of psychology have this character of being accessible to but one or at most a few observers. But science is a mutual understaking, a coöperative task; it is in many respects the most social of all enterprises. Thus an investigator of aches and pains who should, because only his own hurts come home to him, deny their occurrence, would at once disqualify himself as a scientist (except perhaps as a Christian Scientist). A pain investigator must, instead, study pains by whomsoever reported. All the rest of mankind are his assistants, for each has access to an exclusive set of such events, open only to his own report, but being, through the fact of their occurrence, part of the world of nature.

Inspective skill and trustworthy report are, therefore, prime requisites of the psychologist. His work calls for the highest degree of integrity, since, if he errs he may not be detected, and our final public account of nature is false. His personal reports will be important data for other psychologists, who are by them informed of natural events which they would otherwise overlook. Just as a physicist infers electrons and ether, which he does not otherwise encounter, on the basis of activities which he does observe, so the psychologist infers a great variety of otherwise unknown occurrences on the basis of the reports of his fellow men.

CONJECTURE

The process of conjecture has already appeared in our reference to the fact of inference. In conjecture the scientist seeks to go beyond the limits of observed data and to indicate events not yet, and perhaps never, open to his inspection. Thus the diagnostician may conjecture, on the basis of important and observed symptoms, that a tumor, a lesion, or an infection would be found if an operation were undertaken.

The astronomer infers, from movements of the known planets, that one hitherto undescribed would appear under appropriate circumstances. From structural resemblances, vestigial organs, embryological data, and the facts of heredity and variation, the biologist infers a long historical development called evolution. From remnants of implements, drawings, and buildings, the explorer postulates an extinct and perhaps prehistoric race. On the basis of the course and coherent organization of some natural events, most men conjecture the existence of a stable and structured reality, abiding without reference to our momentary experience, and called by such names as "being," "the physical world," "the real world."

In a similar way the psychologist may conjecture. On the basis of the words or grimaces of a neighbor, he may infer aches or motives or memories in what is called that neighbor's "private world." The activities of animals have led him to speculation concerning their possible or probable "conscious states." The course of his own emotions, or the symptoms of neurotic patients may lead him to infer "demons" or "complexes" or "unconscious wishes" in the lives of human beings. Very often the course of observed human activities, encountered personally or through the reports of others, stimulates him to conjecture concerning an elaborate set of presumed processes occurring in a correlated brain or nervous system.

Now since inference is a mental process, it should be found to follow the pattern of all mental sequences. In such sequences, as we have seen, a detail functions for a larger context of which it was formerly a part. For the diagnostician to infer a tumor is for him to proceed, in the presence

of a sign, as on other occasions when tumors were demonstrably in evidence. The explorer's report of the extinct race is patterned after his observations, on other occasions, of the close connection between implements and human beings. The psychologist's inferred pains or motives, likewise, are only other hurts and incentives of the kind with which he is familiar at first hand.

That is to say, inference is limited by history. Conjectured events must be built from the repertoire of immediate observation, by duplication, analogy, or combination. Hence the astronomer's conjectured agents are but other planets, like those of his readier acquaintance, and men conceive their gods after their own images. For logical implication, which underlies inference, does not occur until it has been found to be warranted. When it occurs, it is the reaction to a sign or fragment as if a larger context were present. The imputed context is of necessity built on the model of contexts actually encountered. Thus the electrons of theoretical physics are but miniature thunderbolts, the atoms and vortices but diminutive granules and whirlwinds. Even the mathematical formulas are but highly symbolic indications of gross experiments in manipulating the materials of "sense experience."

A distinction may be made between words which conveniently generalize or succinctly formulate the course of observed events, and names given to inferred or conjectured occurrences. Thus gravitation, electricity, instinct, intelligence are generalizations or classifications of the course of immediately observed events. But they readily lose this status and come to be thought the names of agents, powers, or substances in an inferred realm of physical or mental structure. Demons, the ether, phlogiston, and vitamins, on the other hand, seem to have been from the beginning names used for conjectured agencies. The "reification" of names is a dangerous source of confusion in any science, and one from which traditional psychology has been by no means free.

The psychologist, although his primary task is a descriptive one, feels privileged not only to describe and correlate such events as he encounters, but to infer on the basis of some of

these (called reports, expressions, signs), the occurrence of further natural events not directly accessible to him. Even in using reports of his own experience, whether in the form of memories or of other records, he reacts to these as signs or fragments of larger wholes which they "represent." This is inference, and psychological inference is under the common limitations: it cannot devise totally unique constructs but must work in terms of the personal observations of individual psychologists.

Science, in describing the world, must employ worldly categories. The explanation of natural events, even through inference and conjecture, is only the more comprehensive description and correlation of the events themselves. For psychology, as for all science, there is no "supernatural" realm.

APPLICATION

Since science is approximately accurate description of nature, and since natural events follow certain uniformities, scientific results may be valuable for prediction. The more nearly complete they are the greater is their predictive value. Practical activities constantly utilize scientific knowledge, if it is intelligible to practical men. But since scientific formulations are often highly technical and abstruse, it is often necessary to interpret them in terms of the concrete demands of daily life. The man of science is often the first to realize the bearing of his results upon the daily endeavors of mankind. For this reason, as science becomes more and more complex, applications, or at least suggestions concerning possibilities of application, become part of its activities. The chemist can advise the farmer; the astronomer can guide the sailor; the anatomist can instruct the artist; and psychology may be helpful in the practical life of any human being.

Not every scientist performs all the tasks of science. Some specialize in observation and exploration, some in analysis and correlation, others in conjecture and speculation, and still others in practical advice and application. Thus in psychology some workers are chiefly occupied in experiment and

investigation, while others engage by preference in calculation and analysis or in generalization and theoretical elaboration. Still other psychologists are active in such applied fields as education, management, publicity, correction, psychotherapy, and the like. But it is probable that the best proficiency in any of these tasks will require a reasonable degree of skill and experience in all the others.

THE SCOPE OF THIS BOOK

It follows that no single text such as this can with reasonable success present the whole of any elaborate science. There was a time when one volume could include not only the established data and principles of psychology but also its few applications and its many conjectures. But those days are behind us. Each field of application now has its manuals and journals, its bureaus of research and special laboratories. Many fields of descriptive inquiry—as in space perception, learning, language, child study, mental measurement—now require a lifetime before the accumulated observations are familiar. Fortunately, as these changes have occurred, conjecture has languished and speculation declined.

The present book is devoted, in the main, to the systematic description of the facts and principles of general psychology, with particular reference to the mental activities of human beings. Methodology, technique, and special fields of application are only incidentally considered. Many correlated facts, such as those of physiology and neurology, are left out of account. We seek above all for an adequate and verifiable account of the nature and principles of things psychological. Applications are in any case contingent upon some systematic conception. Faulty conceptions have often served useful practical ends. There is reason to hope that valid descriptions may be even more fruitful.

A descriptive account shows that the two sets of data with which psychology is concerned show much overlapping, not only with data of other kinds but also with each other. For one thing, such reports as speech, writing, gesture, and graphic

record occur only in the activities of human beings. Various other signs, such as postures, attitudes, cries, and bodily expressions, are found only in those complicated systems called animals. The reports on which we rely for our joint account of nature are largely, if not entirely, the activities of those visual-tactile objects (animals, higher and lower) of which redintegrative behavior is so marked a characteristic. Furthermore, at least most of my "private" events, which other reporters do not confirm, occur in immediate correlation with that animal form known as "my body." And the reports by others of events inaccessible to me I can correlate with many of the activities of those visual-tactile complexes called "their bodies."

Of course, there are many other correlations of equal interest. Thus my own private events are mutually intercorrelated: my one-sided headache is closely associated with my visual migraine figure. The private events of others, as disclosed by their reports, are also intercorrelated: my friend reports that his migraine figure is accompanied by that organic experience called nausea. And the consistently reported events, the objective or physical occurrences, are intercorrelated in very complex fashion. The rainbow depends on sunlight and raindrops; the volume of a gas is negatively correlated with its pressure; when one end of a tilt board is elevated the other is depressed; and the circumference of a circle is 3.1416 times as long as its diameter.

But the close relationship between the inconsistent events of nature and those events involved in redintegrative sequences has resulted in the occupation of psychology not only with these two sets of data, but also with their mutual correlations. It is for this reason that psychology is sometimes said to be the study of consciousness, and at other times to be the science of animal behavior. At present at least it is occupied with both these fields, although there are signs of an approaching division into two sciences, occupied respectively with these two sets of data.

CHAPTER IV

GENERAL LAWS OF REDINTEGRATION

THE FACTOR OF COMPLEXITY

In a redintegrative sequence, as we have seen, a group of co-stimuli constitute the antecedent of a response or consequent, which is also usually complex, composed of distinguishable elements. Let us examine the "fear" that ensues upon the "appearance of a snake," and note the numerous details of antecedent and consequent.

In the first place "the appearance of the snake" is complex. "The snake" itself is a very elaborate pattern of occurrences; the color, the shape, the size, the movements are some of the partial features. Moreover, the "appearance" implies the presence of a further background from which this pattern emerges. There are also adjacent objects, the time, place, and other attendant circumstances. The fear is not of the snake merely, but of the "situation." If the snake is lifeless, or securely caged, or if adequate means of protection are at hand, the consequent is changed. It may be not fear but curiosity or pride or rage instead. The original stimuli to our emotions are often of this complex situational kind, not simple qualities like noise or color, but "occasions" such as: "a large, striped, hissing shape gliding rapidly toward me, in a remote section of the prairie, where no assistance is within hail and no convenient means of defense or of medical treatment are near."

The fear which ensues is also a very complex pattern of events. There is, for one thing, a unique set of "sensory qualities"—tension, chill, palpitation, dizziness, and varied quivers. There is an abrupt halt in current activities. Excitement, confusion, panic may occur, and such actions as screaming,

blanching, trembling, fleeing, or fainting. The whole situation is also colored by strong disagreeableness and perhaps also by such feelings as shame or despair. Some of these events are reported in common by the actor and by other observers—as the screaming, trembling, and running. Other features can be directly observed and reported only by the fearful—as the dizziness, the shame, the chill, the tension, and the unpleasantness. Many features might be inferred, though not directly reported, by others—the panic, the excitement, the fainting. Even the private features might be tentatively conjectured by observers who had encountered such events in their own lives. But such conjectures would be relatively insecure and could be confirmed only by the direct report of the frightened individual or system.

THE NATURE OF IDENTITY

Observation of ourselves and others shows that thereafter the incomplete recurrence of this pattern of antecedents is commonly followed by incomplete recurrence of the response pattern. In this connection a purely linguistic difficulty must be dealt with, and with sufficient clearness so that it need not obtrude itself into later discussion nor compel constant pedantry and circumlocution. It is, of course, true that the particular fear just described can never actually *recur*. Fears that have passed are never resurrected; they are gone forever, just as former earthquakes and wars can never repeat themselves. It is always a *new* earthquake, *another* war; so also the later fears are *different* ones. No matter how great the resemblance, two fears, whenever they occur, are at least numerically and historically distinct. So also are two sounds, two renditions of a song, and two instances of the word "box."

This is true in spite of the fact that we may call them the same tone, the same song, the same word. Identity is only persistence in or membership in a *class;* and a class is a temporally extended event or series which we name. Since each detail of an event belongs in its own class or classes, complex events may display various degrees of class relationship.These

range from slight similarity or overlapping of classes, to resemblance so great that class differences of the details are indiscernible. Thus the patterns *ABCDE* and *ABCDF* are very similar. Only one letter is different and even in that case the difference is in a single stroke of the "*E*," which the "*F*" lacks. But even the patterns *ABCDE* and *ABCDE* are not strictly identical. For one thing, their respective locations in space are different, and there are various other differences. Thus one is older than the other, having been written first. And they are not equally familiar.

Hereafter, therefore, when we say "the same event," "the same stimulus," "the same response," and so on, it must be clearly understood that we are not implying that events have ghosts which appear in nature. Nature is by definition a *procession* of events. Although a given reporter can observe a certain *span* of them, whether simultaneously or successively, he cannot recover nor reproduce events that have gone. For us, then, "the same event" can mean only "another event in a given class"; and a class is a series that is not fully constituted until all the particulars comprising it have occurred. With these warnings in mind, no confusion need be caused by our following those convenient linguistic customs which call two events the same if they are, for a given purpose, indiscriminable, or if one can be substituted for the other without changing the practical character of the result. It is necessary only to avoid the popular interpretations of linguistic usages, which have in times past misled not only poets and priests, but logicians and philosophers as well.

SELECTION OF A CONCRETE EXAMPLE

We wish now to present some of the more *general* laws of redintegrative sequence—certain outstanding aspects which appear in many such situations, along with numerous other features and *special* laws. The special laws will be encountered later on, in the situations to which they more particularly apply. And we wish not only to state these general laws but to illustrate each in a concrete case. For this purpose we

require not a careful and quantitatively determined picture, but a genuine one, that is familiar and intelligible.

We may choose, as the general field for our example, certain of the activities of a neurotic soldier, especially those events which we call his trembling, stammering, and running away. A soldier is, of course, an exceedingly complex event in nature. Quite aside from what we call his "activities," he is a very elaborate, extended, and discontinuous class or series of patterns, chiefly visual and tactile qualities, with those involved sets of relations in which he also constitutes an element or term—the spatial world, the field of time, and the multitude of economic, personal, mechanical, physiological, and social relations that conspire to make him a part of that "objective" nature which all report with more or less consistency. Even the simplest soldier is a highly complex event, but, be it patiently observed, he is an event in that one natural world in which occur also my migraine figure and your toothache. We must study him in the same way—by direct observation of his make-up, his changes, his correlations with other events; through conjecture based on reports of others (including his own testimony); and through inference from his activities and from other observed events in nature.

The particular soldier we choose was named S——. In line of duty on the battle front he fell into a terrible panic of fright on the occasion of a violent shell bombardment. He showed external signs from which we infer intense feelings roughly called fear. His teeth chattered, his knees shook. He started to run with no apparent objective, uttering intermittent and stuttering sounds. Then he collapsed in a heap and showed no gross bodily activity for several hours. Taken to the field hospital, he recovered from his stuporous condition, but was agitated, restless, moved frantically about, stuttered violently when he spoke. Any sudden event served to increase this picture of disorganization which had first appeared on the field of battle. The sound of bursting shells would throw him again into a state of collapse.

He was moved farther back from the front, then to hospitals near the point of embarkation for home. He appeared gradu-

ally to improve, but remained so unfit for military service that he was finally sent to a hospital for chronic cases, in his own country, far from the territory of the war activities. Here he was able to get about without personal assistance and made himself contented in the wards or about the grounds. At this point our observation of him, for the present purpose, may begin, in the light of the history we have recorded. His activities illustrate most of the general laws of redintegrative sequence, and in a somewhat exaggerated way, much as the microscope magnifies the structures which the biologist observes. But there is nothing novel nor artificial about the picture, no features that, in somewhat less dramatic form, are not characteristic of redintegrative sequences everywhere in nature.

EFFECTIVENESS OF PARTIAL STIMULI

The first fact of prime importance for psychology is that consequents (responses) may follow fragments or partial details of their former antecedents (stimuli). So long as S—— was not brought into contact with rapidly changing events, his activities seemed ordinary. But certain events would, if he were in their proximity, speedily touch off a characteristic pattern of activity, including either stammering, trembling, or running aimlessly away, or some combination of these. A sudden sound, a slap on the back, the passing of an officer in uniform, a dog fight, or the handling of weapons or knives—any one of these was commonly followed by a mild panic in which trembling, stammering, or running might appear. *A response follows a detail of its former antecedent.*

COMPLETENESS OF RESPONSE AND STIMULUS

A second principle is that the completeness of a redintegrated response may vary with the completeness of the stimulus. Consequents aroused by partial details of their former antecedents are likely to be incomplete. Some of their elements may be missing, those present may not arise so promptly, and they may be less intense and less prolonged; that is to say, a

response to a partial detail of a former context is likely also to be a partial response. But it is a response which is similar to the original and, for purposes of description and often for purposes of practical life, is "the same" response, that is, one for which a given class name is appropriate. It is "identical" in this sense only.

The neurotic responses of the soldier were by no means as violent nor as persistent as was the response to the original experience on the battle front. Some of the elements were often not exhibited. The response was particularly violent and complex if two effective stimuli occurred together, or if one, as a sound, were exceptionally sudden or intense. He once encountered an officer in uniform on a sidewalk, separated from adjacent fields by a muddy ditch. At that moment a motorcycle engine near by suddenly began to pop loudly. S——, who had tremulously begun to reply to the officer's query, now shook violently and began to stammer explosively. He then suddenly sprang from the sidewalk, floundered through the ditch, and ran unsteadily out into the empty field. *The completeness of the response varies with the completeness of the stimulus.*

PREPOTENT DETAILS

A third important observation is that some of the details of an antecedent are prepotent. They are more effective than others, are more likely to redintegrate the response formerly made to the total situation. These we may call prepotent details; they have what we may designate "greater instigative potentency." What the prepotent details are, in any given situation, or in a given general field, is a matter for special inquiry in each case, although general principles will also appear in later sections of our text.

S—— was not equally easily affected by all of the details to which he was in general susceptible. The stimulating episodes were not all of equal stimulating power. Noises were most effective; a sudden push or slap came next; weakest of all were such visual events as the officer and the weapons. It may be that the noise of exploding shells was the most prominent

or persistent feature of the original experience. *Some details are prepotent, others less effective.*

SPECIAL DETERMINANTS OF POTENCY

A given detail may vary in instigative potency, depending on its original intensity or prominence, on its temporal position in the stimulating series (whether early or late), on the various other contexts in which it has occurred in the past, on the recency of the original sequence, on the frequency of its encounter; and especially it may depend on the redintegrative tendencies of other details now occurring with or near it. There are numerous other conditions or determinants of detail potency, which again are matters for careful investigation in every field.

We have already seen that sounds appeared to have their special potency in part, at least, because of their prominence in the original situation, in the case of S——. This may also have been accentuated because of the frequency with which such stimuli were encountered even in civilian life and especially about a military hospital, with its numerous calls, signals, and salutes. Gradually, in part perhaps merely through lapse of time, S—— became less and less sensitive to all these influences. These special determinants of potency are more clearly illustrated in quantitative experiments, such as those discussed in a later chapter.

SYNERGY AND INHIBITION

Stimulating details from the same or from different contexts may work together, thus reënforcing each other (synergy); or they may be opposed in direction and tend to neutralize each other (inhibition). When different events would lead to similar consequents or to responses that do not mutually interfere, they are called consistent, harmonious, congruous, or compatible. When they would lead, separately, to different and interfering responses, they are called inconsistent, contradictory, incompatible.

We have seen how clearly in the case of S—— the occurrence of two details (in whatever present contexts) served to increase the complexity and vigor of his responses. The coincidence of the popping motor-cycle sounds with the appearance of the officer served to produce a response of such violence as strongly to resemble that of the original experience. But the element of collapse did not appear except on one occasion. Then he confronted at that moment a noisy scene in which were mingled loud sounds, fighting dogs, and an excited group of officers and other soldiers on the street. *Stimulating details may thus reënforce each other.* Examples of *inhibition* will appear more clearly in the case of quantitative experiments. But the gradual improvement in the condition of S—— as he was removed farther away from the scene of battle was probably not due merely to the lessened frequency of encounter of potent details. We may suppose that the inhibiting effect of nonmilitary activities was also present.

ORGANIZATION OF POTENCIES

A detail's potency thus depends, among other things, on the nature of all other details, from whatever contexts, present in a given situation. In as much as the tendency of each detail is to provoke consequents appropriate to its own past contexts, it is clear that the effect of a given stimulus pattern may be described as the resultant of numerous tendencies, each related to the past contexts of the stimulating details comprising the pattern. As a history develops, then, *each consequent comes to be the expression of the total past life of the system,* in its elaborate organization and integration. It becomes constantly more and more difficult to trace the causal relations of antecedent and consequent. For this reason psychology as a science is more successful in its attempts to describe the earlier activities of any system of events with which it deals. Thus experiments with children are often more instructive than those with adults.

S—— was observed to be less liable to his uncontrollable activities when on the streets of a city near the hospital.

Even loud and sudden noises then had less effect upon him, apparently because concurrent stimuli worked in other directions; the situation lacked a military background. Passers-by wore civilian clothes; no romping comrades bumped against him; sounds were accompanied by sights of wagons, workmen, trucks, and the like objects. But a dog fight on the street suddenly threw him into a typical attack. *The potency of a detail will depend upon other details, from whatever context, present in the momentary situation.*

VARIATION IN ANTECEDENT CONTEXTS

Some total antecedent contexts endow their details with greater instigative potency than do other contexts. Since a given detail may have participated in many contexts, its particular redintegrative influence on a given occurrence will also vary with differences in the past contexts in which it has appeared. Some contexts of stimuli seem to require frequent repetition before their details acquire that potency which details in other antecedents display after a single occurrence.

S—— was much improved by putting him to work in the Curative Work Shop. Here he was encouraged to use noisy tools and to encounter loud sounds in new contexts, especially loud noises over which he had control and for which he could listen in advance. These activities and new contexts served clearly to modify the redintegrative effects of noises and other sudden shocks. But it was necessary to repeat these experiences many, many times before they appreciably modified the effects of the single experience on the battle front. Some contexts endow their details with greater instigative potency than do others. It was quite remarkable to observe the special potency given to sounds, sights, and contacts by this single battle experience. Such events S—— had encountered throughout his life (a quarter of a century). But this particular situation was so impressive that more joyous contexts, such as Fourth of July celebrations, hunting expeditions, and the like, were quite overweighed and obscured. In

such a complex system as a soldier it would be impossible to trace the elaborate way in which all these ordinary contexts conspired with the one impressive one, either by way of reënforcement or by way of inhibition.

VARIETIES OF INCOMPLETE STIMULI

Considering the stimulus or antecedent, we may indicate three conspicuous modes of incompleteness, all of which may have redintegrative potency. The *part* that functions for an antecedent total context may be:

(*a*) Some fragmentary detail, which in its present form or in coöperation with other details, was an effective feature of the original antecedent. In the case of the soldier S—— the sustained salvos of cannon fire required at the military hospital on the day of an ex-president's death, threw the patient into a pitiful state of relapse. Such explosive noises were an integral part of the situation leading to his original collapse.

(*b*) As the result of the original experience, a similar stimulus but one of lower intensity or smaller magnitude may acquire an efficacy which it did not formerly possess. The partiality of the detail may thus take merely the form of a slighter degree or smaller amount of the original stimulus material. Thus the fear reactions of S—— were, in the beginning, made only to sounds that were terrific explosions. But, in his later days in the hospital, noises which seemed to others quite ordinary were for him very effective stimuli.

Redintegrative activity is present even in those cases in which the only change in the stimulus is an intensity reduction. In this form the continuous gradations between redintegrative (mental) and nonredintegrative (physical) sequences is clearly seen. Simple muscular acts come to be executed with *less effort*, as the result of repetition and practice. Even "purely mechanical" machines (automobiles, windmills, typewriters) require *less energy* for their operations after a preliminary period of use. The wrinkles of one's coat, once established, recur thereafter on "the slightest provocation." It

is manifestly impossible to draw a sharp line between "mental" and "physical," even in terms of the redintegrative sequence.

(*c*) In the third variety, some coincident, accessory, and originally irrelevant item tends to become "a part" of a context along with which it has several or many times occurred. The response to which it would have led independently becomes also part of the total consequent or co-response, although perhaps a very obscure and often overlooked part. The accessory item thereupon serves to provoke not only its own characteristic consequent; it instigates that co-response of which this minor consequent is now a constituent.

Thus the earlier reactions of the soldier to the appearance of a uniformed officer might have consisted merely or chiefly in attentive visual scrutiny of this individual. After his experience on the battlefield and throughout his hospital life, such spectacles as officers were constant features of the situations leading to his neurotic behavior. It was an officer who managed the gun salutes, who supervised the weapons, who shouted commands. After many repetitions of this concurrence, the spectacle of an officer led not only to visual exploration, as formerly, but also to the neurotic trembling.

Many observations of this pattern of redintegrative sequence have been made on lower animals such as dogs. Thus, in one of the typical experiments, it is found that the dog secretes saliva (his mouth waters) following the *taste* of food. The *sight* of the food leads first only to careful visual inspection and sniffling exploration. The *sound* made by bells leads at first chiefly to a pricking up of ears and a turning of the head. But if the dog is repeatedly *shown* the food each time he receives it, and if on each such occasion a *bell* is rung, these co-stimuli become effective joint details of a complex antecedent, which includes also the *taste* of food. Thereafter the bell leads to the co-response—pricking up the ears, visual attention, secreting saliva. The sight or even the taste of food leads not only to salivary secretion but also to concurrent activity of eyes and ears. All these may be somewhat modified in their integration, as indicated by the foregoing general laws.

Such cases have often been named "conditioned reflexes"

or "conditioned reactions," under the misguided impression that only salivary secretion, in which the physiologist is especially interested, comprised the response, and that this response was in some obscure way "transferred" to the new stimuli. It should be clear from the account we have given that we consider the so-called conditioned reaction but an instance of one of the modes of redintegrative sequence. It is what happens in a redintegrative situation when the "independent" responses to the accessory stimulus are obscure or overlooked or of little practical interest to the observer. The conditioned reaction, in its classical form is but a half-described, misunderstood, and ofter artificially produced instance of redintegrative sequence. Properly interpreted, however, it affords a convenient situation for experimental analysis and measurement. Some of the more relevant results of such experiments will be reviewed in a following chapter.

READINESS OF RESPONSE FEATURES

Considering the elements of the consequent rather than those of the antecedent, we observe that *some features of a response are more readily redintegrated than are other features.* The particular character of a response and the various types and degrees of completeness which it exhibits are thus also functions of the original response pattern itself. The influences responsible for such variations are very complex and must be independently indicated in various fields.

But we have already noted that, in the case of S——, trembling was very easily produced. Stammering followed only more sudden or more violent sounds or shocks. The visual pattern of an officer would induce trembling but not, ordinarily, marked stammering. For the whole set of responses (trembling, stammering, fleeing) to appear, required a combination of such circumstances, or very unusual ones of an exciting character, such as the dog fight. Some features of a response are more easily redintegrated than others.

As time went on and all kinds of stimuli were encountered in a variety of contexts, S—— gradually improved, until, not

long after the armistice, he was discharged as recovered. The occurrence of the armistice served to change the contextual character of almost every stimulus: every experience was now a step on the way home instead of toward the trenches. Detail potency varies with lapse of time, with recency and frequency of encounter, with varied contextual inclusion, and with numerous other factors.

SYNTHESIS OF RESPONSE ITEMS

A detail common to two former antecedent contexts, or two details from different contexts, may, as we have seen, lead toward two responses that may or may not be compatible, because of the degrees of congruity or incongruity of some of their constituents. In such a case the redintegrated consequent or co-response often takes the form of some *resultant* or *synthesis* of the two patterns. What form the resultant takes, as a function of response details alone, will depend on such factors as the mechanics and structures of their execution, as for example the muscles and levers (bones) involved, the nervous pathways concerned in innervation, and the various chemical, electrical, physiological processes correlated with the respective consequents.

As we have seen, S—— tended to react to the appearance of an officer by general incoördination and trembling. But, by virtue of other contexts in his past, he also tended to react to such an object by movements of optical fixation and exploration. The actual eye movements on given occasions were observed to be a resultant of these two modes of activity —tentative and unsteady visual regard, interrupted or modified by furtive glances of evasion; or a general pointing of the eyes in the direction of the officer, with the axes of vision parallel, as if looking beyond him at some distant object on the horizon.

SUBJECTIVE AND OBJECTIVE REDINTEGRATION

It is of considerable systematic importance that "subjective" events, those not open to general inspection, may behave quite

as do events consistently reported by all observers. All alike may participate in redintegrative sequences. The events we have just been considering were the *activities* of the soldier, his conduct as an organism in the space and time of the public world. But S—— reports that other events, not accessible to our general inspection, also occurred. Not only did he see his own trembling and hear his stammering voice. Sudden stimuli, he says, were followed also by feelings of confusion, dread, and excitement. There were "prickling" sensations, widespread strains and tensions, "numbness" in parts of his body, and sometimes what he called "pictures of the battle" and "gloomy thoughts about the war."

None of these events was observable by those who watched him, although they are perhaps readily *conjectured* from his words and *inferred* from much of his conduct. They were, however, events in that private region of nature often called "his consciousness." We judge them to be like such experiences as our own, just as we conceive the trees he reports to be very like (if not entirely identical with) the trees we know. We therefore include them in our account.

Nor is the mere correlation of such events with such of his behavior as we can observe or with assumed events in his nervous system an adequate *description of them.* What S—— calls his *depression* may be correlated closely with what we call the tonus of his musculature. His *disagreeableness* may depend on interfering nerve impulses in his body. What he calls *tension* may be determined by the shortening of his muscles or by the simultaneous contraction of antagonistic muscle groups; and so on. S—— has nearly as good opportunity to observe his nerves and muscles as we have, and in precisely the same way. But he would never confuse his *gloom,* his *unpleasantness,* his *excitement* or *tension* with these neuro-muscular structures, nor with their visual pattern changes.

Nerves and muscles, as known to physiology are "physical," in the sense that they are consistently reported patterns, chiefly visual in quality, with particular and elaborate spatial, temporal, and mechanical relations. Dread, depression, excite-

ment, and tension are not visual patterns at all, however intimately they may be *correlated* with such events. The most that can possibly be said in this direction is that the close correlation may suggest that the visual qualities and mechanical relations reported by all, and those other qualities and relations known directly only to S—— may be *different* features of some more inclusive context. But all these features occur in nature.

It has been suggested, in the history of psychology, that they are but "two aspects" of some "one thing." But such a "thing" is not a natural event; it is a conjecture. And under any circumstance it is not the neuromuscular system, any more than it is the gloom or tension. An "itch" may be closely correlated with "a dry spot on the skin." But any one who has an itch knows very well the difference between it and a dry spot. They are different events, however closely associated, and it seems only a bit of gratuitous mysticism to insist that they are two aspects of some one and unobservable thing. No examination of the dry spot would reveal an itch, and by no analysis of an itch could a dry spot be discovered. Yet both occur in nature, and with manifold correlations. Our present interest lies in the significant fact that redintegrative patterns are not limited to the muscular and glandular activities of organisms. Such individually variable events as strains, moods, images, aches, pains, itches, and thoughts also participate in redintegrative sequences. "Subjective" as well as "objective" events have their activities, and exhibit behavior that may be designated *mental*. In so far as this is the case, both exist "in the mind."

THE NATURE OF MIND

The past context, once passed, has become a fact of history. *Its efficacy in the present is not due to its "reproduction," nor to "copies" of it that are in any way preserved.* To be sure, reports of it may be given, as in speech, writing, gesture. Inanimate evidence may be found which leads to the continued inference of its having once occurred. And there is some

evidence that quite new events, called "mental images," may occur which present many of the relations of the former episode. But the past context does not become effective through any magical mode of revival or perpetuation. Instead it is the case that some present detail acts as a *surrogate* for the past context, or resembles it in its instigative influence. In this sense a present detail may be said to stand for, represent, or point to the past or absent.

These redintegrative activities of the soldier *are* what we mean by "his mind." It was because "his mind was affected" that he was sent to a hospital for functional mental difficulties. Mind is but a name we give to natural sequences of this redintegrative type. S—— displayed mind or mental activity, that is, he reacted to signs or details *as if* the wholes were present. Nor did he first hear the sounds (for example), then revive "in his psyche" a reproduction of the battle scene, and thereupon react to that ghost of an event long gone by. There was no "reinstatement of the past" in his world of nature. Instead, some *present detail functioned for* that past event, in something like the way that past event operated when it did occur. Both stimulus and response were relatively incomplete, but their resemblance to the originals is obvious. The mind of the soldier was this repertoire of responses to symbols of past or absent contexts. The mind therefore involves more than the soldier.

And although S—— displayed mentality (reacted to signs), he lacked sagacity. For a long time the *concurrent* details of the present contexts in which the potent stimuli occurred were ineffective. Responses were overdetermined by past contexts, in neglect of present situations. This is why we call this soldier "neurotic," for this is one of the forms in which a psychoneurosis may appear.

Nor did these past contexts exist "buried in his unconscious." Unless "the unconscious" means only "the past," the words are mere nonsense; and if they mean "the past" they are superfluous. The past events have their place, to be sure, but their place is in *history,* not in mythical or allegorical worlds of unconscious ghosts.

SUMMARY OF GENERAL REDINTEGRATIVE LAWS

The general laws considered in this chapter may now be assembled, each in the form of a brief statement.

1. Identical events are those persisting or belonging in a given class.
2. Consequents may follow fragments or partial details of their former antecedents.
3. The completeness of a redintegrated response varies with the completeness of its stimulus.
4. Some of the details of an antecedent context have special instigative potency.
5. The potency of a given detail varies with a great many determinants, such as prominence, temporal position, contextual inclusion, recency, frequency, and concurrent details.
6. A detail's momentary potency is a complex resultant of all its effective determinants.
7. Stimulating details may reënforce or inhibit one another.
8. Each consequent comes in time to be an expression of the total past life of the system in which it occurs.
9. Some antecedent contexts endow their details with superior instigative potency.
10. Varieties of stimulus incompleteness may be classified as those due to partiality, reduction, and concurrence.
11. Some features of a co-response are more easily redintegrated than others.
12. Simultaneous response tendencies combine or synthesize in various ways, producing resultant patterns of compatible features.
13. Both "subjective" and "objective" events participate in redintegrative sequences.
14. The efficacy of a past context is not due to its "reproduction" nor to its "unconscious persistence"; instead, some present detail acts as its surrogate.
15. A mind is the sum total of redintegrative activities exhibited in or by a given system of events.

CHAPTER V

OBJECTIVE EXPERIMENTS IN REDINTEGRATION

THE MENTAL PARADIGM

The redintegrative sequence, in the forms we have described, is the fundamental feature of mental process, the paradigm of all those activities which we call psychological. The great array of common names for mental activities, such names as perception, imagination, memory, learning, judgment, reasoning, motivation, and the like, may suggest that there are many distinguishable mental processes. In a sense this is true, the sense being that redintegrative sequences may occur in different systems, involving different materials, with manifold modes of combination and modification. It is useful to have different names for these discriminable situations. But their mentality, their psychological character, is found first of all in their common exhibition of the redintegrative pattern. Activities are therefore *mental,* not because they are made of some unique "psychic" stuff, nor because they are the performances of a soul, nor because they occur in a fabled realm, that of "consciousness." Mental activities are processes in the natural world; their action is the change of natural events when the pattern of this change is redintegrative—when consequents follow partial details of former antecedents.

We may, therefore, use the features of the redintegrative pattern as a diagram, outline, schema, or paradigm, which will be our guide in all psychological investigation. We may conveniently represent these features, and their relations, by simple lines and figures, as in the following diagrams, which might well be called the coat of arms of every psychological enterprise.

In these diagrams we have the schematic analysis of a very simple mental sequence such as those involving, or exhibited by, that animate structure or system which we call a snail.[1] We may for the moment confine ourselves to those events which are objective—the visual changes, in space and time, involving a piece of lettuce, the neuro-muscular structures of the snail's body, and the movements of writing points (recording levers) attached to the mouth and foot of this small animal.

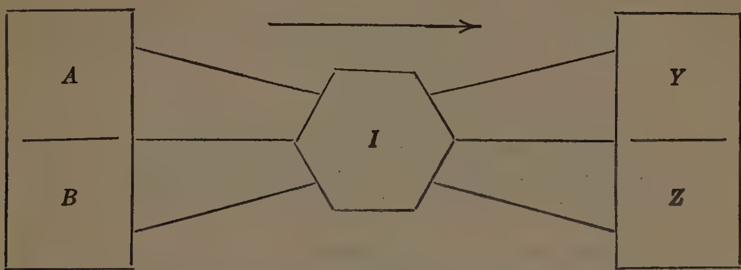

Fig. 1.—Diagram of a simple redintegrative pattern or mind: primary situation, co-stimuli *AB* evoking co-responsive *YZ*; the hexagon *I* indicates various intervening events.

The observed facts are as follows. Event *A* (Fig. 1) is "pressure of a piece of lettuce against the snail's mouth"; event *Y*, the response to *A*, is "movement of the recording lever attached to the mouth, betraying chewing movements of the mouth parts." Event *B* (also Fig. 1) is "pressure of lettuce against the snail's foot," and its observed consequent *Z* is "activity of writing lever connected with snail's foot." *AB* leads to *YZ*.

We need not now inquire "how it happens" that *A* alone leads to *Y*, whereas *B* leads to *Z* instead. These may be strikingly "physical" sequences (reflexes) involving the nervous system of the snail in a series of purely "mechanical" changes, determined by the snail's original structure and illustrating what we call "heredity." Or each may have its own history

[1] See E. L. Thompson, "An Analysis of the Learning Process in the Snail," *Behavior Monographs*, Vol. III (1916), p. 3.

of development, in the light of previous activities of the system, and hence be cases of what we call "learning." To-day they occur, and for our present purpose we may start with them as our first observations.

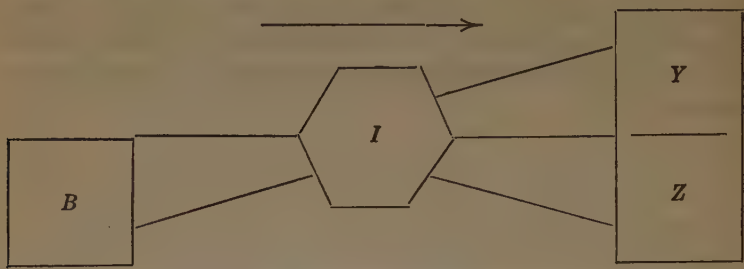

FIG. 2.—DIAGRAM OF A SIMPLE REDINTEGRATIVE PATTERN OR MIND: SECONDARY SITUATION, PARTIAL STIMULUS EVOKING TOTAL CO-RESPONSE; THE HEXAGON *I* INDICATES VARIOUS INTERVENING EVENTS.

Between stimulus *A* and its consequent *Y*, as also between *B* and *Z*, there are numerous "intervening events," which we designate in the diagrams (Figs. 1 and 2) simply by the hexagon marked *I*. These intervening events are also consequents of *A* and *B*—such as the changes in the nervous system of the snail, disturbances of its skin and its sense organs, contractions of its muscles. If we preferred, we could stop by one of these events and consider it the "consequent" of *A* or of *B*. Or we could take instead changes occurring still later, such as the air currents following upon the movements of the recording levers.

For any subsequent event may be considered a consequent of any of the numerous antecedents that precede it in a causal series. Hence, just as *A* and *B* might be taken as consequents of earlier events, so also *Y* and *Z* might be considered the antecedents of later consequents. For natural processes are continuous, as far as we are able to observe; the "stimuli" and "responses" are but arbitrarily observed events in such processions.

Now if, a number of times, *A* and *B* occur together (comprise one context or complex antecedent), a very interesting

thing occurs. Either *A* or *B* (or new events sufficiently like them) will be found to result in movements of the $Y + Z$ type. "Pressure of lettuce against foot" leads not only to movements of foot but also to half-hearted chewing movements. And when the lettuce is pressed against the mouth, the snail not only chews but also makes the characteristic foot movements, with half-hearted vigor. This is a mental or redintegrative sequence in which a "part" functions for a previous total context. When *either A or B* occurs, the writing levers move *as though* both *A* and *B* occurred together. This we have diagrammed in Figure 2, using letters for these features of this "test situation."

We have here observed a bit of mind. The mind involves the lettuce, the snail's body, and the movements of the recording levers. We call it "the snail's mind" for several reasons. For one thing, the pieces of lettuce and the various pressures are recognizably "different" on different occasions. The movements of the levers and the levers themselves may also be quite "different" on different days. But we are accustomed to assume that "the snail" has remained "the same" throughout. Thus we readily accept the assertion that it is the same snail but different pressures and various lever movements that are involved.

Moreover, certain of the changes, as the movements of the levers by the snail's foot, the indentation of the skin by the pressing lettuce, and perhaps the "ingoing" and "outgoing" nervous impulses in the snail's body, are more definitely "physical" sequences. They approximate, at least, the patterns of inanimate mechanics. We, therefore, suspect that somewhere, and apparently *in the snail,* there is a point where the radical redintegrative departure from mechanics occurs. And since this point seems to be in the central nervous system of the snail, we are likely to call this "the seat of mind" and to attribute the mind to the nervous system.

But the mind that we have observed is not in the snail, any more than it is in the lettuce or in the recording levers. It is *in nature,* and includes not only the snail but also those events which we have called "the stimulus" and "the response."

EXPERIMENTAL VARIATIONS

It is clear that we may experimentally vary the features involved in such a simple mental situation. Thus we can present *A* and *B* in various temporal positions other than that of simultaneity, as *A*....*B*.... ?; or *B*....*A*.... ?; or *A*..........*B*.... ?; and so on. We can produce these various occurrences seldom or frequently and can vary the duration and magnitude or intensity of each stimulus. We can let varying periods of time elapse, after "training," before "testing," for the effect of one stimulus when presented alone. We can introduce other stimuli in the meantime, or refrain from this. We can experiment with other things than lettuce and pressure, or we can train with certain objects and test with others closely or remotely resembling them.

We can change the snails, and note their individual differences; can compare young snails with old ones; can compare snails with other organisms. We can overfeed or tease or drug the snail, and note the variations produced. We can study in a variety of ways the movements of the recording levers, noting their character, complexity, vigor and duration in time.

If the snail could but employ language and thus serve us as an observational assistant, we might also learn of other affairs going on in nature, in that conjectured region traditionally called "its consciousness." The snail might report pressure, discomfort, pains, memories, and ideas. Moreover, electrical and other instruments connected with the snail's body might provide us with data leading to the conjecture of various occurrences in the snail's nervous system, such as nervous impulses, change of synaptic resistance, differences of osmotic pressure in membranes, movements of negative electrons and hydrogen atoms, and the like, in that also largely conjectured field with which physiology, chemistry, physics, and neurology are concerned.

Crude experiments on this order have been unsystematically conducted by men from the very earliest times. Savages learned that birds could be frightened away by scarecrows if

only a man had appeared a few times before them making a frightful noise, by which they were "reflexly" startled. Simple peasants taught their pack animals to respond to such ejaculations as "Gee" and "Haw" by simultaneously pulling the reins on appropriate sides, thus guiding the animal to left or right. Indeed, very lowly wild animals learned to respond usefully to "danger sounds" of their mates simply by having simultaneously heard their own squawks in moments of panic due to pain or fright or rage. In some such ways arose primitive magic, human speech, and graphic language, the arts of painting, music, sculpture, all literature, and the whole field of science. In all of these affairs we have the spectacle of creatures reacting to symbols (incomplete objects) by modes of reaction more or less appropriate to the actual presence of such objects.

But purposive and quantitative experiments began relatively recently. They may be illustrated by such classical psychological investigations as those of Fechner on psychophysics, Ebbinghaus on memory, Helmholtz on space perception, Kræpelin on individual differences, Galton on imagery and synæsthesia, Thorndike on animal learning, Pavlow and Bechterew on glandular and motor activities, Wundt on the analysis of complex experience into its simpler modes, Cattell on reading and reaction time, and innumerable later investigations.

Since these earlier experiments in the fields indicated, each field has developed into an elaborate set of problems, results, and theories; and entirely new fields of research have opened. It is the task of the student of psychology to become somewhat acquainted with these experimental results, as contrasted with the rough and ready observations evolved in "common sense" since the early days of savagery and magic.

TYPICAL EXPERIMENTAL CONDITIONS

The simplest redintegrative situation for experimental analysis is one in which the following artificial or laboratory conditions are realized:

1. Stimulus A and B are relatively simple and conveniently variable and controllable events, occurring in contexts otherwise constant. Thus A may be the application of an edible substance, in powder form, to the tongue of an animal, and B the sounding of a whistle or organ pipe. The applications must be made in a quiet room, with constant conditions of illumination, ventilation, air currents, furnishings, movements, and the experimenter should preferably be concealed from view, yet able to observe or record what goes on.

2. Response Y (made to A) is preferably some fairly restricted, easily identifiable and measurable change, mechanically (reflexly) following its antecedent, under conditions otherwise constant, and not capable of "voluntary control." Thus Y may be a change in rate of secretion of the salivary gland, or the reflex changes in size of the pupil of the eye, or the automatic movements involved in the knee jerk.

3. Response Z (made to B) is preferably some very inconspicuous change, having little relation to the occurrence of Y. Thus it may be such a trivial event as pricking up of the ear, brief arrest of bodily movements, or some vague and obscure internal bodily adjustment, as a catching of the breath or an increase in pulse rate.

4. Only one-half of this simplest actual redintegrative situation is then chosen for investigation. Response Z is quite ignored, and the reaction to A or to B or to $A + B$ is considered only as the occurrence or nonoccurrence of Y, or some degree or form of Y. Since Y follows A at the start, the experiment consists, then, in studying the way in which B also becomes linked with Y. No attention is paid to the linkage of A with Z. A is then called the "primary or unconditional" stimulus. B is called the "secondary" or "conditional" stimulus, since it is not originally effective in producing Y, but becomes so "under certain conditions."

5. This type of artificially restricted and half-complete observation of a redintegrative situation, even of the simplest degree of complexity, much simplifies the experimenter's task. It is commonly called a conditioned reaction experiment. It is clear that a complete account would also include the other

part of the situation—the linking of A to Z, and also the relations of Y and Z, as responses, to each other. In the actual life conditions in which redintegrative processes occur the whole affair is enormously complicated. For instead of only A and B as antecedents there are any number of stimuli present at a given moment. In place of a constant set of conditions there is an ever changing background. In place of Y and Z being relatively independent processes, they and all the other many consequents involved are mutually related and entangled. The typical conditioned reaction experiment proceeds upon a conjectured "pathway" account of brain activity, a conjecture which is only one of several conceivable ones and is, moreover, not in very good accord with many observed facts.

6. The typical conditioned reaction, as an experiment, however, ignores many intervening and sometimes directly observable or indirectly observable occurrences, such as those occurring in the body of the individual studied. But it is a common practice to indulge in elaborate speculations as to the "probable" nature of these activities. Often the whole redintegrative pattern is theoretically transferred to the region of the nervous system and hypothetically described as a play of activities therein.

But in spite of all this arbitrariness and artificiality, the conditioned reaction experiment serves as a convenient point of departure. The principles derived from it may be suggestively employed in the analysis and explanation of more complex situations which are not so amenable to exact observation and record. We may illustrate the results of such experiments by observations initiated about a quarter century ago by a group of Russian physiologists, chiefly under the leadership of Pavlow.

They observed, for example, such mental sequences as those involving:

(*a*) Sounding whistles or organ pipes, and the presence of edible substances placed on the tongue of

(*b*) the living organism of a hungry hunting dog with an artificial opening (fistula) to the salivary gland, which enabled the experimenter to collect

(*c*) the salivary secretion, in a tube, drop by drop, each drop moving a recording lever (tambour needle) which traced its movements on a revolving smoked drum (kymograph), in company with the recorded strokes of a timing machine (chronoscope).

Varying certain of the features experimentally, the investigators were enabled to make observations such as the following, which are really assembled from several investigations of this general kind.[2]

SOME LAWS OF THE CONDITIONED REACTION

1. Applying edible substances to the tongue produced a flow of saliva. When used as stimuli repeatedly, such substances lead to a reduced salivary flow. Application of certain inedible substances also resulted in salivary flow, which, however, increased with repetition of the stimuli.

2. Secretion to edible substances increases as the interval between stimuli is lengthened, whereas that to inedible substances, under the same circumstances, diminishes.

3. Sounding of organ pipe or whistle, alone, had no observed result on the rate of salivary secretion before training.

4. After a number of simultaneous soundings of the tone with the applications of food, the tone alone was followed by increased salivary flow. In some cases a single such "training" or joint application was all that was needed. Usually a considerable number, as from twenty to forty "trainings" were required, in the case of the dog.

5. The temporal position of stimulus *B* (the sound) is important. If, instead of occurring simultaneously with the food, the sound *follows the secretion* of saliva (*Y*) to the food (*A*), it does not become able to affect the flow, even after many hundred "trainings." Nor does it become effective if it precedes *A* (the food) by too long an interval.

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[2] Useful surveys and bibliographies on the conditioned reaction investigations are to be found in: Yerkes and Morgulis, "The Method of Pavlow in Animal Psychology," *Psychological Bulletin,* Aug. 15, 1909; H. Cason, "The Conditioned Reflex or Conditioned Response as a Common Activity of Living Organisms," *Psychological Bulletin,* Vol. XXII (August, 1925), p. 8.

6. In some interesting cases, if B begins before $A \ldots . Y$, by a certain interval (say three seconds), the conditioned secretion to B (the sound) occurs, but not until a similar lapse of time (three seconds) after its application begins; that is, the effective stimulus comes to be not merely the *occurrence* of B but its persistence for a given time. Even if B ceases before A appears, B may be found effective after training, provided the interval be not too great. But the secretion to B (the sound) will thereafter also be delayed, by an interval approximating the original separation of B (sound) and A (food), or B and Y (secretion). In such a case the response is said to be not to the actual conditioned stimulus (B), but merely to its "trace" in the animal's nervous system, that is, to some unobserved *consequent* of B which is actually active at the moment when A leads to the unconditioned secretion.

7. Such conditioned salivary flow as may be provoked by the sound, in these various conditions, is likely to be slower or of less amount or of poorer quality (viscidity) than that originally following the joint stimulation by food and sound.

8. Other sounds, differing not too much from the one used in the "training," would also now produce salivary flow, the quantity and quality decreasing as the difference of the sounds became greater. Salivary changes could thus be correlated with differences in quality, intensity, and pitch of the sounds employed.

9. These conditioned secretions to sounds might continue to appear for a period as long as two months, provided nothing were in the meantime done to disturb them.

10. If a complex sound (chord) were originally used, thereafter one of the elements of this complex would, occurring alone and with sufficient intensity, produce characteristic secretory changes, usually of less degree or amount.

11. Conditioned secretions to sounds died out gradually if the "test" was often repeated (without accompanying food); but they were quickly restored upon one or more joint reapplications of the two stimuli.

12. Conditioned secretions were inhibited (ceased to occur) by such changes as the use of an entirely foreign sound,

the addition of an unfamiliar tone to the original chord, the substitution of an unfamiliar for a familiar tone in the original complex. The degree of inhibition was directly related to the intensity of the new or inhibiting sound.

13. Conditioned reactions, worn out by repetition or by inhibiting stimuli, might on later occasions sometimes recur without retraining; or they might be revived by some foreign stimulus or shock, which effect has been described as "the inhibition of an inhibition."

14. Very complex forms of inhibition, combination, and reënforcement were sometimes observed in the mutual relations of partial, complete, fundamental, and conditioned reactions, and in their dependence on such features as the nature of the stimulus, time relations, and the like. Especially interesting are:

(*a*) The conditioned response Y (actually, of course, some total response, as $X + Y$, XY, xy, etc.) is not called out merely by the occurrence of B (the specific detail) as an isolated event. Instead it is linked to this detail plus its setting, its time relations, its duration, its attendant circumstances, its "traces," other consequents to which B leads, and so on.

(*b*) The fact of "irradiation," as it has been called, that at first any one of a considerable number of stimuli, somewhat *like* B (belonging in its general but not its specific class) are effective. Only after repeated training does the conditioned response become *specifically* attached to B or to stimuli *closely* resembling it. Thus in experiments with dogs, in which the secondary stimulus was not a sounding whistle but "scratching the dog's skin at a certain point," the conditioned secretion was shortly found upon scratching the skin *at any point*. In general then, the effective detail (b) need not be a precise *duplicate* of B. It needs, at least under certain circumstances, to resemble B only in *certain respects;* that is, the effective detail may be very, very incomplete and still produce a consequent recognizably in class with the original consequent.

15. These conditioned reactions, produced under artificial laboratory conditions, are unstable and variable. They often

rapidly disappear and are readily "inhibited" or disturbed by the intrusion of extraneous events.

16. Such patterns represent modes of occurrence closely involving a given individual system (animal). The "training" of one individual does not affect other members of the species, nor is there adequate evidence that the intervening nervous changes in any way affect the organization or conduct of the subsequent offspring of the trained individual.

THE PHENOMENON OF ADAPTATION

Special attention may be called at this point to the experimental demonstration that the secondary stimulus loses its potency for the conditioned response, with repetition, unless occasionally reënforced by the original context. This is "adaptation," and it is a striking feature of secondary stimuli. The elements of the co-response natively attributable to such a stimulus do not fall away with its repetition. But the conditioned items, for which other stimuli were chiefly responsible, do so as a rule. We may suppose that this is usually because, with lapse of time, the secondary cue or detail becomes an item of various newer contexts for which it comes to function instead. It thus acquires new directions of potency, while the first acquired tendency wanes with time. These newer and often uncontrolled contexts become in time more effective than the original experimental one.

A spider, secreted in its nest, may dash out upon its web when the threads are jarred. If the experiment is often repeated and no captive fly allowed to accompany the disturbance, the spider in time ceases to make this response. This is variously described; the spider "becomes adapted"; "ceases to pay attention"; the response "is inhibited," is "detached from the stimulus," and so on. The simplest explanation would seem to be that the jerking web was throughout a redintegrative stimulus. In the beginning it functioned for its usual past contexts, including an entangled object of prey. Through the experiment, it came to function more effectively for a new context, an empty snare. Hence it now

evokes the response of "sitting tight" instead of "rushing to the fray."

As thus conceived, "adaptation" or "inhibition" means the acquisition of new redintegrative consequents. It may even be possible that wherever adaptation, in the psychological sense, occurs, the process is that of the displacement of former consequents by the intrusion of new contexts. Even our failure to report sensory qualities in the presence of continuous objective stimuli, as described in Chapter XXIII, may be due to the substitution of other adjustments in the place of attentive regard. Thus also we become adapted to terrifying situations, as details, frightful because of their former dangerous contexts, now come to function for the present innocuous contexts. Stage fright, for example, is best overcome by repeated public appearance. We have here strayed somewhat from the immediate topic of this chapter. But this is for the sake of calling attention to the bearing of some of its material on the subject matter of chapters to come.

SPECIAL AND GENERAL LAWS

After reading these particular findings in the case of the dog's salivary activities, it will be useful to review the general laws of redintegration, given in the preceding chapter. It will be seen that these special findings constitute only instances of those general laws, but instances in which definite facts, such as the necessary number of "trainings," the time over which the effect persists, the exact effect of temporal position, and the like, can be stated. And these findings, for the particular setting of the experiment, cannot be immediately carried over to other situations. Each situation, for example each animal species, each mode of stimulation, each type of response, and so on, has its own set of specific determinants.

We may use these findings in the case of the conditioned salivary reflex of the hunting dog, to sounds, as a source of suggestions relating to the reëducation of neurotics, the training of children, the teaching of tricks to animals, the analysis of space perception, the production of "mental images," and

other topics. But in each instance we may expect to find very special factors peculiar to the general field of observation. Our next project will be to take in turn certain of these topics and to apply to them the paradigm derived from our general laws of redintegration, just as, in the present instance, we have shown the application of this paradigm to the case of conditioned salivary secretions of the dog.

CHAPTER VI

TYPICAL SUBJECTIVE REDINTEGRATIONS

PRELIMINARY INDICATIONS

We have said that psychology is concerned, *in part,* with the study of subjective events, as well as with redintegrative sequences. And we have had frequent occasion to note that subjective, as well as objective events participate in such patterns. The consideration of typical instances will, therefore, serve not only to advance our acquaintance with redintegration but also to exhibit some of the more common varieties of subjective occurrences. Subjective events, it should be remembered, were defined as those discrepantly reported, chiefly because of their accessibility, in a given form, to only one or a few reporters. For the present purpose we may confine our discussion to a few conspicuously subjective occurrences, such as those of *sense imagery, synæsthesia, number forms, sensory auræ, simple æsthetic feelings, idiosyncrasies of taste,* and certain characteristic *personal attitudes.*

We shall throughout the discussion need to make use of the reader's acquaintance at first hand with certain very common affairs of nature. We may at later points be interested in these varieties of facts themselves, especially since some of them have a somewhat subjective character. But for the time being, these are only materials or tools for the illustration of events and sequences showing still greater degrees of subjectivity. It is sufficient to recognize that we are to use them in this way, even before we have attempted their detailed description or analysis. We refer to such generally accepted facts as that:

(*a*) Under certain conditions things in the world have aspects which we designate by such words as yellow, smooth, bright, cold,

soft, painful. These are often known as the various "sensory qualities" of objects.

(*b*) In various situations we may experience characteristic "feelings" which, however simple or complex, are commonly called by such single names as pleasure, aversion, joy, drowsiness, animosity, fear, excitement, regret, and the like. These "come to us," much as do brightness or cold.

(*c*) To various people, topics, or situations we find our "selves" taking such familiar attitudes as resistance, shrinking, attack, co-operation, obedience, respect, laughter, and the like. These events also "overcome" us, much as do the feelings and the sensory qualities which are encountered.

That such episodes as these should occur in nature is of great interest not only to psychologists but to nearly every human being. We shall later need to inquire more closely into their character, their behavior, and especially into other natural facts with which they seem to be correlated. For the present we wish to show, not how such events as these occur, but, instead, how their occurrence may give rise to other and more individually discrepant experiences, which may vary greatly among different observers. We may begin with the sense image, one of the most debated of psychological topics.

THE GENESIS OF MENTAL IMAGES

Such events as sounds, tastes, odors, colors, and the like, or objects having these among their characteristics, may occur either in *sensory* or in *imaginal* form. They are called sensory when various particular or combined conditions are fulfilled; otherwise they are called imaginal or "mental." We now inquire into the differences between a "mental color," for example, and an "actual" or sensory color. Such qualities or objects are called sensory under the following conditions, or some combination of them:

(*a*) When nearly all reporters encounter them simultaneously or in close succession, and render harmonious accounts of them.

(*b*) When their occurrence is closely correlated with *other* demonstrably sensory evidence, for a given observer (as when sight is confirmed by touch or sound, and so on).

(*c*) When other observers consistently report, not such a particular quality or object, but certain other occurrences (in the public world), which are commonly correlated with such particular events (as their conditions, occasions, stimuli).

(*d*) When certain intrinsic cues (such as behavior, intensity, prominence, persistence, and the like) are found, which are usually present when such events are in other ways known to be sensory.

(*e*) When the event is recognizably like certain clearly defined but relatively unusual things that have been described as "peculiarities," arising under special conditions, chiefly those of disease, or disturbance of the normal course of nature.

Suppose, for example, that I observe a dancing bright point of light in the direction in which I look. Is it a sensory brightness or an imaginal one? If my neighbors also report it with unanimity (confirmation) its sensory character is probably granted. If warmth accompanies the brightness, or if the latter disappears when opaque objects are held before my face (verification by attendant events) the conclusion is sensory. If I note that the flash comes only when I press a finger against my eyeball, or if any one discovers a lamp or a firefly in the neighborhood (correlated conditions or stimuli) the verdict is reënforced. If the light is very intense or persistent and does not follow my eye movements (cues and behavior) this at least favors its sensory characterization. Finally, if it assumes the form of the well known migraine figure or the character of "entoptic phenomena," all of which are familiar sensory disturbances, it may be called sensory even though all the other criteria are lacking.

But if such conditions are unfulfilled, and I still insist that I *see* the light, the verdict is likely to be that what I am reporting is "only a mental image," perhaps "the mental image of a firefly's flash." Since the reported visual character (the brightness and the location in visual space) is vouched for by my direct inspection, I may be said to have "seen a flash that is not *there*," the "there" meaning "where others can find it."

By the mental image is thus meant a quality for which there corresponds no other event, publicly reported, such as is ordinarily the correlate, condition, or stimulus of such a flash. The physiologist might insist that "some nervous change"

could undoubtedly be correlated with it. It must not be forgotten that this would be no more than *another* event, and hence an explanation only in the sense of correlation. The physiologist is especially interested in neural rather than in political, domestic, or affective correlates. He might further point out that in the absence of a suitable peripheral stimulus (correlated sensory event) the flash must be said to have been "centrally aroused."

By this he would mean that the nervous event presumably correlated with it must have been initiated by activity from some source other than that which usually initiates such a change. This is very close to the truth, since, as we shall now undertake to make clear, imaginal qualities are redintegrated sensory qualities, instigated by some partial detail of their former antecedents. Mental images are redintegrated objects, incomplete perceptions, initiated by incomplete antecedents, just as the neurotic trembling of the soldier, in an earlier chapter, was an incomplete duplication of his overpowering collapse on the battlefield. After showing this to be the case we shall consider in some detail the nature of images themselves and their rôle in other mental activities.

In order to describe the genesis of mental images we may use the very simple situation in which a child is taught by adults to know the colors by name.[1] The child is given a pack of cardboard squares, bearing on one side the printed letters spelling the color names. On the other side are various pigments which, when held before the open normal eye, in daylight, lead the observer to report the appearance of various colors. Suppose, for convenience, that one card bears the letters YELLOW, and its reverse side is spread with ochre pigment. When this reverse side is turned up before the eyes, that event occurs which we call "appearance of a yellow square," or simply "yellow square."

This sequence, turning over the YELLOW card, followed by

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[1] A similar explanation is suggested by R. S. Woodworth *Psychology* (Henry Holt & Company, 1921), p. 403, and a detailed analysis in terms of conditioning is given by H. Cason, "General Aspects of the Conditioned Response," *Psychological Review,* July, 1925, pp. 303 *ff*.

appearance of "yellow patch," is a physical affair, the further account of which physiology and physics undertake to give. There is nothing "mental" about such colors, they are immediate and unanalyzable events in nature. When such a yellow patch appears in the field of view, under the conditions described, it is called a "sensory" or "perceptual" or "objective" yellow. Under the conditions, it is an essential feature of the thing, the piece of cardboard. This is an elaborate *object*, with many distinguishable features, such as size, shape, location, weight, color, and the like, all closely correlated with one another and with other affairs. It is important to realize that the appearance of a particular quality, such as a yellow color, when its appropriate "physical and physiological conditions" are fulfilled, is an inexplicable mystery or natural fact. We can only recognize and describe it, and correlate it with other natural facts, such as those which we call its "conditions."

Each time the teacher turns up the YELLOW card, he also speaks aloud the word "yellow," which means that I, the child, find in the world another event, the noise which is the spoken word "yellow." We have then a sequence oft repeated, in which the antecedent is the complex total:

> Turning the square card, bearing the printed YELLOW, the reverse side being spread with ochre pigment, before my eyes, in daylight.

The consequent is also very complex, and consists of the following:

> Sensory yellow appears in the visual field and the sound of the word "yellow" appears in the auditory field. A visual and an auditory object appear conjointly in nature.

Thereafter, if this situation be truly a redintegrative one, a portion of the antecedent tends to evoke an incomplete duplicate of the consequent. And this is precisely what does occur. On a later occasion the printed word YELLOW suffices to produce, perhaps unsteadily, and somewhat sluggishly, "a yellow patch" of varying vividness—a *mental* or *imaginal*

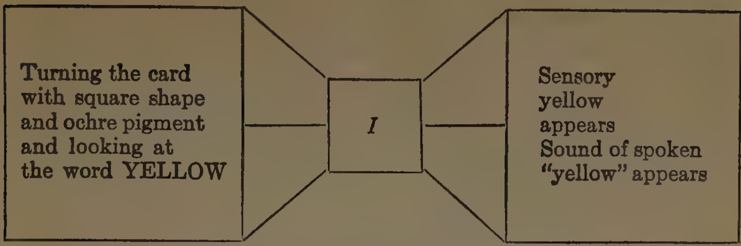


Fig. 3.—The primary situation.

yellow. And this printed word may also be followed by the sound, usually faint, of the word "yellow," "heard in the mind's ear."

The mere sight of a square card, or the act of turning over a bit of cardboard, or the appearance of some other square object, might also tend, theoretically, to evoke these visual and auditory images. But this does not commonly occur since such details have been features of so many contexts (all the other color cards) that the various possible consequents are mutually "inhibited." That it does, however, occasionally occur we shall see in the discussion of synæsthesia. We may now diagram this general set of events in terms of the redintegrative paradigm. Such a diagram is a statement of the "conditions of appearance," and hence is quite as "explanatory" as the physical and physiological account of the "production" of the original "sensory qualities."

In the diagrams (Figs. 3 and 4) we have our familiar pattern, with the small middle square indicating merely the

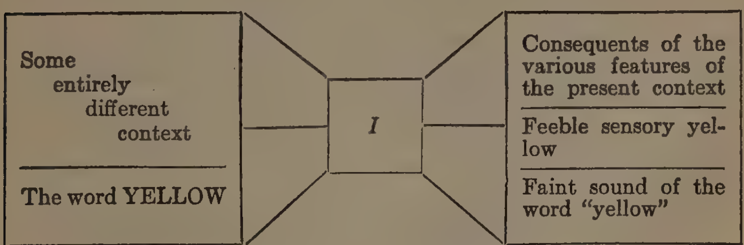


Fig. 4.—The secondary. redintegrative situation.

fact that many "intervening events" (*I*) occur in the actual sequence from what we have chosen to call "antecedent" to what we have chosen as the interesting "consequent." The important point is that, in the secondary situation, one feature of the original context, such as the word YELLOW, is potent to invoke incomplete duplication of the important features of the original response. The obscurity of such "mental qualities" is seen to be due not merely to their incompleteness, but also to the presence of other features, due to other elements of the present antecedent context.

Such "objects of imagination" are very common experiences. They are like diluted or weakened forms of their "originals," except under special conditions, when the two are not easily distinguished, and hallucination ensues, especially if accessory criteria are not available or are rejected. Images are incomplete perceptual objects. Their incompleteness takes various forms, such as fainter intensity, fugitive persistence, lack of substance or resistance, absence of details, unsteadiness, and the like.

Sense images may appear in any field in which sensory objects occur; they may be of sound, taste, smell, touch, and so on. The word "image" is very poorly suited to their description since it so strongly suggests optical images and hence visual qualities. But the long history of the word in psychology seems to justify its retention as the general and convenient name for "redintegrated objects" of a relatively subjective order. They may be very simple (a flash, a chill, a tolling bell) or very complex (a melody coursing through the head, a dramatic series of dream episodes, a complicated reverie). They may appear with great fidelity and purity (determined by a single context) or may represent complex patterns of contamination or fusion (from numerous contexts). They are in large measure "such stuff as dreams are made on"; they play an important rôle in reverie and in all degrees of phantasy, ranging from normal daydreaming to the hallucinations and illusions of the psychopathic.

Especially in childhood, they seem to serve conveniently as "symbols" of absent objects and thus become important ma-

terials in thinking, remembering, planning, and the like. With advance in skill in the use of speech, print, and writing, these later modes of symbolism often displace the more cumbersome "centrally aroused" sense images. Such imaginal "representations" are by no means essential for thinking; indeed, they may often impede thought by their sluggishness, their inexactness and their instability. Many individuals who think with great cogency insist that they have no images at all; many who have them do not use them in reflection and find them most vivid in certain moments of relaxation or fatigue, such as drowsiness. Some psychologists, with pronounced verbal habits, failing to find images in their own adult world, have even belligerently denied that they ever occur anywhere in nature.

In waking life and in dreams of the more elaborate sort, visual and auditory images are more commonly reported. Images of qualities belonging to the so-called lower senses are reported with less confidence and unanimity, although under certain conditions, such as the transition between sleeping and waking, they often appear more definitely. From the readiness with which children confuse "sensed" objects with "fancied" ones, it is inferred that childhood images are more frequent, more vivid, and more utilized than is the case in adult life. Adults apparently differ enormously not only in the quality and vividness of their imagery, but also in their preoccupation with and use of it. For images may be "used," just as may other objects occurring in nature. They may also occur without being used.

Images are among the oldest topics of psychological interest, and many painstaking studies of them have been reported. It was once supposed that all "ideas" occur in imaginal form, and many older writers seem to have supposed that "thinking" is merely a "stream of images." We shall see the great error of this assumption, although the important rôle of redintegrated objects cannot be denied. We shall in chapters to come have much occasion to refer to the psychological rôle of such incomplete duplicates of former perceptions. For the present it is enough to note that these redintegrated objects are highly

subjective, being variably and discrepantly reported. The diverse past histories of different people lead to great diversity in the reports of their images, just as the diverse histories of soldiers lead to varying neurotic symptom pictures, and the diverse histories of dogs to varying acts of salivary secretion. Such events (images) belong to that general class of occurrences which, because of the *extreme* variability in different reports under stimulus conditions apparently the same, can be studied only by that individual mode of observation called introspection. But, of course, images do not occur "within" us; they occur in nature, in that same natural world in which our bodies and our reports occur. If only images could be evoked with sufficient consistency in different observers, they would take their place in objective nature, along with the sensory objects on which different reports agree so closely. Even under the actual circumstances of their production, there are often occasions in which it is impossible, except through prolonged and careful experimental investigation, to distinguish between "actual" and redintegrated objects—as in childhood, dreams, and various psychopathic conditions. Even under certain laboratory conditions in which by careful prearrangement the observers are denied access to accessory clues or criteria and must depend solely on the inspection of the objects themselves, such confusion occurs.

SYNÆSTHESIAS

Still more subjective (variable) are those instances in which a quality or relation of one sort, arising from "adequate" stimulation, is accompanied by more or less bizarre, redintegrated, attendant qualities, often from a different sensory field. Thus in one case, each letter of the alphabet, when heard spoken, evoked a different color. Musical tones were also variously colored, according to their pitch. In another case words spoken in German appeared green; English words were brown; while Greek words were yellowish. In many cases that have been reported the sound of the vowel *i* is said to be a "dark" sound, while that of *o* is white or light-colored.

These various cases are called instances of colored hearing. They occur both among children and among adults.

In still other cases colors or sounds evoke characteristic tastes—so-called cases of gustatory audition and auditory gustation. Thus one subject who was studied insisted that most words have characteristic tastes or pressures. The word "hope" tasted like celery; "marry" had the taste of raisins; and the name "Emma" tasted like pie crust. In still other cases various shapes, such as circles, triangles, have marked color qualities accompanying them. Another reports that pains have their distinctive colors: "hollow pain was blue; sore pains were red; headaches were vivid scarlet; shooting neuralgia pains were white." For another person studied, tastes were colored: sweet tastes were usually black, bitters were red, salty tastes were grayish, and sours were greenish.

In some instances such synæsthesias were so vivid and persistent as to facilitate or to interfere with the individual's ordinary life. They had the same coerciveness as did sensory qualities with "adequate" stimuli. Thus one man had difficulty with arithmetic because the numbers had such lively "associated qualities." On the other hand, in another case "so faithful were the associations of colors with digits that the subject was able to perform mathematical operations by means of colors." Singers have been reported who were "able to judge the accuracy of pitch by means of the fine differences in shades and tints of the colored tones." But another has reported a study of his own colored hearing "which proved to be of so great an annoyance to him in his music that he had to give up his musical education."

Although nearly every one observes the occurrence of images in response to such stimuli as words, these bizarre synæsthesias seem to occur to only about 12 per cent of adults, and perhaps twice as frequently to adolescents. Individuals differ strikingly even when such experiences are reported. There is little or no agreement from individual to individual, and changes often occur in the reports of a given person. It is clear that these synæsthetic qualities are highly subjective, even more subjective than mental imagery. But there seems no reason

to doubt the accuracy of all the reports.[2] The most probable mechanism of production has already been suggested in our diagram of the genesis of the mental image.

Suppose, for example, that in the case of the colored cards there described, the red card had been triangular, the orange card square, the yellow a circle, the green a star, and so on. Each shape would then have been an intrinsic and characteristic feature of the antecedent leading to a given color. In keeping with the general redintegrative laws, we might under such circumstances expect the various *shapes,* wherever encountered, to evoke incomplete color qualities, as readily as would the words (the color names). Thus the triangle would evoke a mental red, and might readily be said to *seem* red. But this redness, because of the uncommon conditions of its origin, might not be reported by others, who learned the colors under different circumstances. Its occurrence in an isolated case or in a few cases would, therefore, be called a synæsthesia. Ordinary synæsthesias are apparently only usual cases of mental imagery, evoked by special stimuli, and due to particular past contexts in the life of the individuals giving the reports. In fact *many* people think of the various countries of the globe as having different colors—the ones given them in the old geography maps. For similar reasons most people think of north as "up" and of south as "down."

NUMBER FORMS

Redintegrated objects (images) also often appear in characteristic and predetermined arrangements, which seem at the moment irrelevant. The most familiar of these are the *number forms,* which only some 6 per cent of the people investigated seem to have. When the individual with a number form pictures the various numbers, these are seen in definite locations, directions, and distances from one another and from the observer. Thus one man found his imaginal numbers

[2] A useful summary and bibliography of the investigations in this field will be found in R. H. Wheeler, "The Synæsthesia of a Blind Subject," *University of Oregon Publications,* Vol. I (May, 1920), p. 5.

arranged in the following form, spread out before him and below him in space:

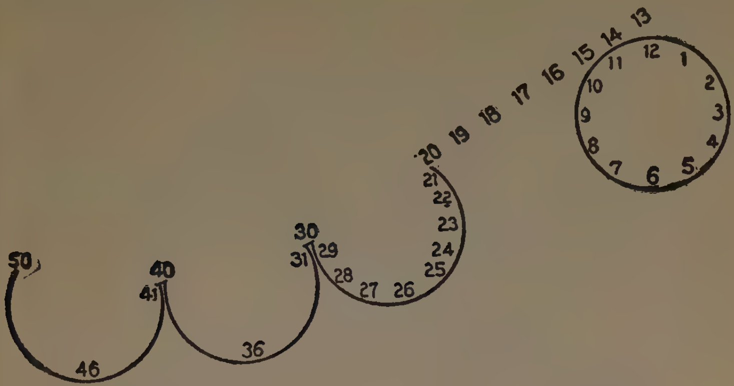


FIG. 5.—THE NUMBER FORM OF A BRITISH PROFESSOR.
Adapted from T. H. Pear, "Number Forms," *Memoirs and Proceedings of the Manchester Literary and Philosophical Society,* LXVI, No. 2 (1922), p. 2.

This person, in seeking to explain the genesis of his number form says: "I cannot explain the origin of the almost straight lines between 12 and 20, but the curves came from the fact that I learned to tell time before I learned to count, and when I did learn, everything reverted to the picture of that old clock. . . . I was much fascinated by clocks and watches as a child and could tell time almost as soon as I could talk. . . . The ¾ circles in my form are, I suppose, the remains of the clock face, and this would explain why 6 is always the lowest figure in the circle." [See thus 26, 36, 46.]

Those who find number forms differ widely in their descriptions. The phenomena are highly subjective but seem no less genuine than are the aches and pains which we attribute to others because of their reports of them. In an early essay on number forms Galton wrote: "The pattern in which the numerals are seen is by no means the same in different persons, but assumes the most grotesque variety of shapes, which run in all sorts of angles, bends, curves and zigzags. . . . Drawings, however, fail in giving the idea of their apparent size to those who see them; they usually occupy a wider range than

the mental eye can take in at a glance, and compel it to wander. Sometimes they are nearly panoramic."[3]

The great subjectivity of number forms seems again to be a function of their redintegrative origin. They seem to date from particularly vivid or interesting or frequent early episodes, much as did the neurotic symptoms of the soldier S——, of our earlier chapter. Because of the great variety and combination of such contexts in individual histories, there is little objectivity or uniformity in the reports of different observers, and many are unable even to recognize anything like number forms in the world.

AMBIGUOUS SUBJECTIVE EVENTS

The various degrees of subjectivity of such events as sensory qualities, images, synæsthesias, and number forms have a systematic interest. Thus nearly every one will agree, when two tuning forks, named C′ and G′, are sounded, that the G′ is "higher in pitch" than the C′. On the question of the existence and character of images of these sounds there will be some disagreement, but a distinct majority will find such images and report them as less intense than the originals. Certainly not over 10 per cent will report that the tones are definitely colored, and even these will not agree upon the assigned color qualities. Not over 5 per cent of those asked will locate the vibration rates of these tones in a number form, and those who do so will describe widely discrepant arrangements. But still higher degrees of subjectivity than this occur. Thus about one person in a thousand or more will be found who hears such sounds (auditory auræ), perhaps quite clearly, when no one else reports them, and when neither adequate nor partial stimuli can be discovered. It is thus clear that no sharp dividing line can be drawn between subjective (discrepant) and objective (concordant) occurrences.

Considerable psychological interest attaches to such dubiously sensory events as afterimages, contrast effects, migraine

[3] F. Galton, *Inquiries into Human Faculty* (Macmillan Company, 1883), p. 80.

figures, and the various types of auræ often found in special cases. Their interest arises from the fact that such events are not supposed to point to or imply other occurrences outside the nervous system of the individual who reports them. Ordinary lights, sounds, odors, contacts, and the like, are given a "transcendental" value; they point, it is said, to "external stimuli" in the "physical world," in addition to "depending on" such conditions as nervous activities. Organic sensations, such as pain, thirst, fatigue, while they do not point to anything beyond the body, do "indicate" changes in the bodily organs, aside from the "nervous events" on which they "depend."

But the events we have mentioned (afterimages, auræ, etc.) have little or no extra-nervous implication; they are said to result merely from the nervous activities which are their correlates. These nervous activities may sometimes be a continuation or consequent of earlier nervous changes, with which other sensory occurrences were correlated, and to which some *former* external stimulus did correspond. But in other cases even this mode of production cannot be verified. A few illustrations will make the matter clearer.

When I look at a bright light, which is at once extinguished, I *continue* to see a luminous spot in the field of view. But it follows my eye movements, as the original light did not, and it has its own characteristic behavior. It changes in intensity, varies in size, undergoes striking color transformations, is unsteady and intermittent, and yet is seen not "in my eye" but out before me, covering objects at which I direct my gaze. It gradually diminishes in vividness and after a time disappears. It cannot ordinarily be revived nor duplicated except by again looking at a similar bright light, although suitable words may provoke a "mental image" of it. This fading luminous spot in the visual field is a "sensory afterimage." Similar aftersensations may occur in at least some of the other sensory fields, although there is conflicting testimony in such cases.

Such afterimages are theoretically correlated either with the gradually subsiding activity in the nervous system, or possibly with continued chemical, electrical, or other activity in the

peripheral sense organ, as the eye, the skin, etc. Such affairs are ambiguously objective and equivocally sensory. They appear only under specified conditions, and agreement in their report is fairly good, at least in the case of vision. But events of this sort, it may be noted, are in a sense incomplete duplicates of their originals. They are described as resulting from incomplete and gradually fading nervous activity of the sort responsible for their originals. In their particular form they are essentially "private," more so at least than the original "bright light" reported by all.

With the aftersensation and its mode of production we seem then to be in an intermediate, ambiguous realm, between sensory and imaginal quality, between objective and subjective character, and between physical and mental modes of sequence. In as much as we began our book by declaring the existence of just such a continuum of events, we need not be disturbed by the difficulty of applying the conventional twofold classification to such occurrences. There are many more like them.

Another good instance is that of the sensory quality aroused by "inadequate stimulation." Thus a luminous spot may be produced vividly by looking at a bright light (adequate stimulus). But a less intense luminous spot may also be evoked by pressing the side of the eyeball with the end of the finger (inadequate stimulus). In the same way "cold" may follow the tapping of a properly selected spot on the skin with a toothpick of neutral temperature. There are many similar instances of qualities following "inadequate stimulation."

Is such a luminous spot sensory and objective, or the contrary? It is commonly called sensory, since it is clearly correlated with another event (pressure on eyeball). But it is at least ambiguously objective; it does not "point" beyond the eye, and it is quite a private affair. Moreover, the technical term "inadequate stimulus" is curiously like our term "incomplete antecedent." It seems far from nonsense to suggest that such a luminous spot is the incomplete duplication of a consequent ordinarily following more "complete" or adequate excitation. Again we are landed halfway between

redintegrative and physical, between sensory and imaginal, between objective and subjective. By this time we should feel quite at home in this ambiguous and intermediate region of the continuum.

SENSORY AURÆ

We must also pay some attention to such occurrences as auræ, in which the relation of antecedent and consequent is very obscure. About one person in a thousand or so is said to have some form of epilepsy; and about half of these cases studied report various curious experiences which do not agree with anything that other observers ordinarily find in nature at the time. These are the various auræ, chiefly sensory and imaginal, though not exclusively in these fields. They commonly precede the typical motor attack. Of the sensory auræ, fully half are visual; auditory auræ are next in frequency; then come those of taste, smell, and organic sensation. This much resembles the distribution of such qualities in waking imagery and in dreams.

The visual auræ are described as flashes of light, series of colors, wavelike motions, visions of animals and other objects, darkness, changes in the size of things seen, and so on. The auditory auræ are roaring noises, voices, buzzing or crashing sounds, tones of whistles, bells, and the like. There are also reported a great variety of lower sense auræ—strange tastes, disagreeable odors, nausea, dizziness, choking, gnawing pains, and the like. More elaborate auræ are also reported, such as a riot of thought, confused imagery, strong emotions, and the like.

Such occurrences are markedly subjective, variable, and private. But their occurrence is vouched for by the intelligence and honesty of many of the observers and by the fact that they are often "mistaken" for events in the public world. In some cases they appear to be partial features of some more impressive occasion which preceded the earliest violent convulsion, and perhaps to act redintegratively in the instigation of subsequent attacks. In other cases these auræ seem themselves evoked, perhaps as part of the complete attack, by

partial features of earlier situations of excitement or stress. But in the larger number of cases they occur inexplicably and their beginning antedates the social history of the individual reporter. It is difficult to see how any but an introspective psychology can study such indisputable events.

In many ways the auræ also seem to belong to that great intermediate stretch of the psychophysical continuum. It will be noted that they violate all but the last two of the suggested criteria of sensory character. This last criterion seems to have been especially provided to accommodate such events to the artificial twofold classification of popular language. The auræ are not "encountered by other reporters"; are not "correlated with other demonstrably sensory evidence"; are not "related to public stimuli"; and yet are "intense, persistent, and behave like sensory events." All that can be said for them is that they are "clearly defined, relatively unusual, and recognizable as peculiarities or disturbances."

But whenever a set of criteria breaks down so completely, it is obvious that the distinctions which the criteria were formulated to serve are less clear-cut than the conventional terms would suggest. Even our convenient but tentative distinction between mental and physical modes of production becomes obscure, in this field of ambiguously objective-subjective, sensory-imaginal occurrences.

We do not know how much of this obscurity is due to the nature of the facts themselves and how much results from our ignorance. Under the circumstances it will be safer to turn again to such subjective events as more clearly conform to the pattern of mental sequence. But it is instructive to realize to what an extent such classifications as abnormal, subjective, and unreal depend solely on that typically political criterion—the vote of the majority.

SIMPLE ÆSTHETIC FEELINGS AND IDIOSYNCRASIES OF TASTE

Various things, such as songs, children, pictures, and flowers, as well as acts, are often described by such terms as sweet or

soft. Faces may be characterized as sour, dispositions as peppery, and words or remarks may be bitter or stinging. And very commonly we hear it said that that water looks cold or the wind sounds cold. In such instances we approach another situation which has much in common with synæsthesia. When two antecedents have the same consequent, we often use a given word for both situations and even attribute the qualities of one to the other.

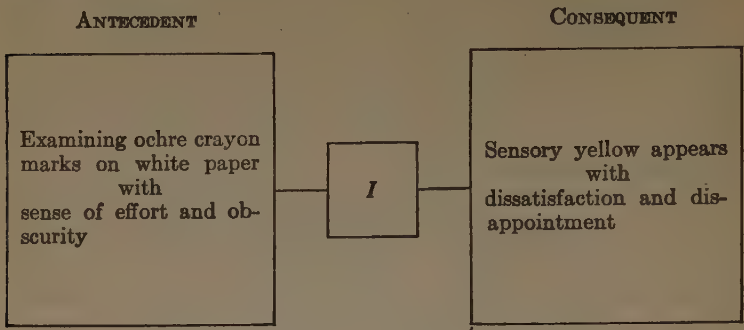
Thus sweet tastes and pretty faces are agreeable. In calling a pretty face sweet, we seem merely to be indicating that the face provokes the same feeling (pleasure) that is aroused by sweet things. Thus antecedents leading to similar consequents are often loosely confused in popular speech. Common feeling tone is the basis of many literary figures of speech, because the name of a familiar antecedent is often employed to describe the nature of the consequent, even when this occurs in response to other stimuli. But this is also a case of the redintegrative sequence, as the following diagram suggests:

Antecedent	*Consequent*
Sugary and pleasant tasting substance in the mouth	The exclamation, "That is sweet!"

Thereafter a single detail of this antecedent, the pleasantness, though occurring in a new context, such as "a smiling, pleasing face in the field of view," evokes the former verbal comment "How sweet!" The close relation of such figurative or analogical experiences to the more strictly sensory forms of synæsthesia is apparent.

This relation is neatly illustrated in the case of a child of three and a half years who told its father: "Soft music is yellow and loud music is black." This sounds very like the classical synæsthesias. Being asked, "Why is soft music yellow and loud music black," this child, still unspoiled by the monstrous explanations of physiological psychology, replied, after a moment: "Well, when you mark with yellow crayon on paper you can't see it very well, but when you mark with black, you can." We may diagram the suggested, and quite

probable, basis of this synæsthetic or simple æsthetic experience as follows:



Thereafter we may expect not only that "sense of effort and obscurity" (as in listening to faint music) will tend to evoke imaginal yellow, as described by this child; but also this ochre color may be felt as unsatisfying or irritating. In a single experience it is possible for music to acquire color quality and for color quality to acquire characteristic feeling tone. That these would be displaced in later life by the constellation of varied contexts is, of course, quite likely, but fragments of them may remain indefinitely.

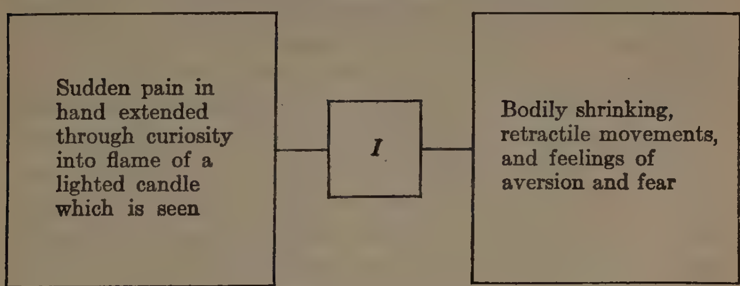
In such ways as this, varying widely among individuals, the relatively simple materials of artistic manipulation—colors, forms, lines, elements of design, arrangements, modes of balance, patterns, rhythms and the like—acquire definite feeling tone, such as they do not originally possess. It is usually futile to seek for objective physiological explanations of the basis or the diversity of these qualities. They more often depend on very early, complex, or forgotten contexts. Since these vary so widely in different individuals, the redintegrated features of new situations will vary correspondingly. This is why the old maxim arose which asserts that "there is no accounting for tastes."

But the old maxim, as is usually the case with such slogans, is only partially true. As we have just indicated, there *does* seem to be a way of *accounting* for tastes, although these may be extremely variable, and their precise histories may be

obscure. Moreover, in many cases these acquired feeling tones have a sufficiently common origin so that many people recognize them. Art forms come to speak a reasonably definite language, at least to certain groups of reporters, if not to the whole population. Thus many agree that "the trumpet has a joyful sound"; that "green is a refreshing color"; that "slow music is depressing." And practically every one recognizes the aptness of describing one man as "upright," another as "crooked," and still others as "sharp" or "dull." The synæsthetic and, hence, the redintegrative basis of such descriptions is apparent.

PERSONAL ATTITUDES

Many characteristic and deep-seated personal attitudes toward people, objects, institutions, and situations are also redintegrative in their genesis. It is this rooting of them in the past and often the early history of individuals that gives them their strikingly subjective character and provides the diversity we commonly find in personal preferences, values, and attitudes. In illustrating the subjectivity and the redintegrative character of these attitudes we may begin with a fairly objective one, indicated by the old saying "The burnt child dreads the fire." The genesis of this attitude of aversion may be shown in such a diagram as the following:



Thereafter not only does "fire" or "visible flame," as a detail of other contexts, provoke incompletely the general attitude of avoidance and the feeling of dread; other details of

the complex antecedent may also do so, and thus "the burnt child" may be wary of all objects that are "curious" or "novel." Thus "inhibited curiosity" and "dread of fire," two personal attitudes that are so common as not to be idiosyncrasies, may become established, if such early inclinations are reënforced by subsequent contexts.

In something like this fashion we may sketch the possible genesis of such personal attitudes as suspicion, submissiveness, prejudice, chivalry, honesty, and the like. On the basis of the general sketches it is valuable to analyze individual instances, whenever it is possible to observe the process in the beginning (as with children or puppies) or to secure reliable histories of the early experiences of older reporters. Sometimes the formative situations occur fortuitously, in the course of life; often they are arranged or controlled by adults, interested in the inculcation of approved attitudes. The diagram provides us with the chief technique of "character formation."

Take, for example, the case of the sensitive child whose early life is successfully dominated by a tyrannical parent, because of juvenile helplessness in the face of the superior size, authority, and economic power of the adult. To such an antecedent context we may suppose that, on repeated occasions, the consequent reaction is an attitude in which fierce animosity and protest combine with reluctant submission. According to the general redintegrative laws, partial details of such an antecedent, later encountered in other contexts, tend to arouse in incomplete form the characteristic reaction.

Thus as an adult such a child may be expected to manifest a temperamental resistance to any or all constituted authorities. He may feel antipathy for large organizations and economically powerful corporations, as well as for individuals resembling his autocratic parent. On the other hand, he might also be expected to exhibit submissive behavior before any one who takes toward him an attitude of mastery, or toward those known to be individually strong and successful. He might thus prefer the companionship of the weak and the forlorn, and with them take up arms against such prevailing

institutions as capital, the Church, compulsory education, and the army. He might indeed find his chief joy in leading revolts against established authorities. Psychoanalysts might declare that such a "radical" was suffering from a "father complex." But this would be only a picturesque way of stating that present details have their potency determined by past contexts, and of specifying vaguely what the particular effective contexts might have been.

In times of war or other conditions of excitement, and even in milder forms of political agitation and rivalry, such tendencies are readily established or manifested. Thus the population of X suffers a vicious national indignity and affront at the hands of community Y. The consequent is opposition and hatred, accompanied by the frequent mention of the enemy name. Thereafter anything on which this name appears is despised, the use of the Y language is tabooed, the literature and science of Y are belittled, and toys manufactured in Y are repudiated or burned. With great zest, effigies, made up to resemble the inhabitants of Y, are burned. And again, any situation involving indignity or affront evokes in auditory imagery the ringing or hissing sound of the hated name. The word Y becomes the synonym for *all* such acts and aggressions. In a similar way the population of Y acquire lasting repugnance for anything with the X label. Such dispositions and attitudes may persist throughout the life of the actors originally involved in them, or they may become modified and displaced by the influence of other contexts, which would be similarly diagrammed.

In somewhat more trivial ways political candidates may be favored because they bear the same name as that of a dear friend, come from the voter's native state, belong to his lodge, or attended his college. A well-known opera singer is said to have refused to vote for a certain able presidential candidate on the ground that "he is too fat." Such candid confession of one's motives is, however, not the rule. More commonly the origin of the prejudice is lost in the past history of the individual, although the personal attitude asserts itself none the less. In such cases the attitude is often logically "defended"

by whatever considerations, of a rational or socially approved order, the individual can devise. Thus our prejudices and attitudes, our preferences and values, are rationalized and justified, on artificially formulated grounds, with little or no discernment of their genuine redintegrative source.

Not only do reprehensible attitudes often originate in this way; our more worthy evaluations may also have a similarly redintegrative basis. Thus a child is kindly cared for by a gentle blonde female companion called his sister. Throughout his subsequent life he may find himself chivalrously and gratefully disposed toward all women, strangely moved to respect for nuns (who are called Sisters), particularly attracted, and quite without reflective consideration, by girls with light hair and complexions. Such attitudes are precisely those to which the redintegrative pattern would lead, on the basis of the earlier contexts.

A popular mode of interpretation attributes such personal attitudes, prejudices, and dispositions to the "activity of the unconscious." If all that is meant by this is that the individual is unable to narrate the various past episodes in which the attitudes originated, such explanations need not be misleading. But the more common idea is one of a more animistic and unintelligible sort. It postulates an "unconscious mind" in which these past episodes, though "submerged," are supposed to be somehow obscurely though effectively present and active. In this form the doctrine of the unconscious belongs in class with other popular bits of folklore, such as those describing the capers of fairies, pixies, and spirits.

It seems more profitable to give a straightforward descriptive account of the ways in which occur such subjective affairs as images, synæsthetic qualities, number forms, idiosyncrasies of taste, and various personal attitudes. The redintegrative paradigm seems to be the general pattern in which such sequences happen. These events seem clearly to be incomplete duplications of former more impressive events. The details now evoking them may have been synergically involved in the original antecedent, or they may have been only incidentally comprised in the original total situation, and yet now

be redintegratively potent. But such events must always be interpreted in terms of the actual detail or stimulus which evokes them. Such a detail, whatever its nature, is what we mean by a sign, symbol, or idea—a thought. There seems, in fact, to be no limit to the applicability of the redintegrative paradigm to the description of those occurrences, which, because of their mode of production, we call mental.

CHAPTER VII

THE TECHNIQUE OF REPORT

THE NATURE OF LANGUAGE

In addition to my own immediate contact with natural events I rely on the reports of others. That is to say, some immediate events, such as these reports themselves, are taken to be the signs of other natural occurrences which may not be accessible to me. The signs on which I most fully rely are those of language, whether in gestural, vocal, graphic, or other form. Thus I may infer, from the mere facial expression of an animal, that it is "in pain"; but my confidence in the occurrence of the pain is much reënforced if the animal delivers a verbal description of this event.

Since the span of nature accessible to a given investigator at a given moment is so limited (see the Chapter on Attention), that social account which the scientist formulates is largely dependent on the reports of others and, therefore, on some form of language. It is necessary before proceeding further to give a description of the nature, genesis, and function of that instrument, and of those natural events which may in general be described as linguistic.

A language is a set of symbols which, in understanding and use, are surrogates for past events and absent objects or situations. In a general and elementary way, loud sounds in the case of the neurotic soldier, the sounding whistle in the case of Pavlow's dog, the vocalization "gee" with which the savage turned his pack animal, and the printed characters YELLOW which produced an imaginal color, are just such symbols.

We are, therefore, already well on our way to the description of language. We need but to elaborate our account so as to include those two chief aspects which we may distinguish respectively as "understanding" and "use." Both these

features are involved in "communication," in the delivery and interpretation of report. We may best approach them by considering such events as are more popularly called linguistic, although in a final sense science treats all natural events as a kind of language—a set of signs for further occurrences, not so readily observable.

Even the term "linguistic" is too inclusive to be served adequately by a single example. Language development consists in the substitution of signs or cues, which we call gestures, words, figures, diagrams, maps, and other symbols, for original events and situations. Language material, as it appears in human life, for example, is by no means restricted to verbal elements and structures. In solitary thinking a rich play of events, comprised of such items as imagery, sub-vocal activities, incipient gestures, strains, postures, sights and sounds, eye movements, feelings, and especially the varied *relations* between such items, also provide an elaborate language, the language of thought, as distinguished from that of communication. One's "self-communion" need by no means utilize the conventional materials of speech and writing. But we can best choose, to illustrate the single genetic principle underlying linguistic development, the case of spoken language.

THE LANGUAGE OF A DOG

The simplest situation involving language is that of mere "understanding." In a very few trials an Irish terrier was taught to "stand up" at the word of command. Each time, while he was hungry, I raised him by the forepaws, saying repeatedly "Stand up! Stand up!" He reflexly made various bodily adjustments which preserved his equilibrium in this position, whereupon I fed him a bit of biscuit for which he had a prodigious appetite and which I secured by opening a drawer in my desk, where a supply was stored. Shortly, he would help raise himself to the erect position upon my starting to lift both his forepaws. After half a dozen such occasions, he would spring up on his hind feet and balance himself expectantly there:

(*a*) When I said "Stand up!" or "Handcuffs!" or "Grandpa!" in a tone of command.

(*b*) At the sight of any small object held aloft in my hand, or my upraised hand, with extended finger.

(*c*) Upon the opening of any drawer in my desk, in his presence.

The dog now "understands" all of these "signals," by which we mean that he reacts to them as he formerly reacted to the larger contexts of which they were but partial details. So far as he and I are concerned, these signals constitute a one-sided language. Through them, as signs or symbols, I can control his conduct in certain respects, namely, in those respects which formerly resulted from more elaborate antecedents. It is unnecessary to sketch this process in terms of the redintegrative paradigm, for it is obviously only another instance of the type of sequence we have already repeatedly analyzed.

It would be interesting to know whether or not the dog's "understanding" is limited to the appropriate act of "standing up" and to his probably increased salivary secretion. Does he also "hear" the words; are there also "mental images," as of biscuits, or tastes, or swallowing, which the dog might describe if he could use language by way of narrative; does he also "feel" the movements which he makes, or can he only "see" them? Naturally our conjectures here would be very insecure; but only because, while the dog may "understand" spoken language, he cannot "employ" it. Animal psychology is, therefore, more profitably occupied with the objective (visual and tactile) changes of the dog as an object in space and time. That is, it is behavioristic, making no use of "introspection," the technique of report. But it is important to note that we apply the word "understanding" even to those spatiotemporal changes, the dog's overt behavior, when this is redintegrated by "signs."

As a matter of fact, this dog's linguistic activities are far from fully described in the foregoing paragraphs. For one thing, with further training, he has come to react more discriminatingly to oral commands. He now responds differently to "Stand up" and "Sit up," with their different inflections,

which at first both brought him to the standing posture. Moreover, he is now unlikely to rise upon the opening of a drawer, unless it is the *middle* drawer, opened in his field of vision. He is much less easily controlled by inedible substances held aloft than by bits of decent food, which he apparently discriminates through their odor. That is, through the various reënforcements and inhibitions of varying contexts, the elements of language are more finely graded and sharply specified.

Nor is this all. To carry further his obedience to the verbal command, this dog was told "Sit up!" on every occasion in which he showed "discomfort," as when thirsty, when futilely trying to get through a closed door, when taken out to relieve his bodily needs. Thus a constant feature of such situations has been an organic condition like those present in my own case when I am "in want," "am striving," or "am dissatisfied." Through training, this "want" has been made to lead repeatedly to "sitting up," through the use of the verbal stimulus. And now, in any such occasion of need, and before any convenient and familiar member of the household, the dog "begs," until some change is made which "satisfies" him.

Is this not a clear case of "using" language, as well as of "understanding" it? For the dog's momentary activities are furthered by the device to which his "inner need" prompts him. And the process of establishment, in this case, was the third form of the redintegrative pattern, which has been called the conditioned reaction. The dog's use of such signs is much more limited than his understanding of the cues utilized by the trainer. Thus he does not specify with any exactness the precise nature of his need, though he does react in specific ways to the trainer's particular cues. It seems not unfair to say that the dog "understands more than he can express."

But this, as we shall see, is a common feature of language. Children understand words much earlier than they can speak. They continue to have a larger vocabulary of understanding than of execution. Most of us can appreciate modes of communication (art, oratory, literature, music, foreign speech) which we cannot ourselves produce. In the field of language,

at least, it is a general rule that "appreciation precedes execution, and continually outruns it."

DISTINCTIVE FEATURES OF HUMAN LANGUAGE

The development of human language follows the redintegrative paradigm quite as neatly as do the understanding and use of signs in the case of the Irish terrier. But human language has the very remarkable advantage that (unlike the dog's symbols) the signs in the repertoire of use (writing, speech) which are primarily motor activities of the actor, result in *products* (graphic patterns and sounds) which coincide with the signs in the repertoire of understanding. Thus the terrier could "understand" sounds and finger gestures, but he could "use" only his own gross bodily posture (sitting up). This act does *not* produce events similar to signs which he understands. But in the case of human language the actor responds to *verbal sounds* (questions) by movements of articulation which in turn produce *verbal sounds* (answers). The repertoire of understanding is thus duplicated by the products of the repertoire of use: spoken and written words are both interpreted and executed.

A distinctive thing about human language is, therefore, that it is a *medium* of communication, just as money is a *medium* of exchange. By the latter statement we do not mean merely that giving money to another will induce him to work. In this respect money would be not a medium but only a stimulus. Money is a *medium* by virtue of the fact that the work, to which another is prompted by it, results in products which come back to me in money form. The products of the activity ultimately duplicate its stimulus in character. It is in a similar way that language becomes, not merely a set of signs, or two sets, one for use and one for understanding, but a *medium* of communication. The muscular activity of writing produces "letters," which are at once the visual alphabet of reading. The oral activities of articulation produce "words," which are at once the aural language of interpretation.

Since not only the sign function of language but also its

character as a medium arises after the typical patterns of mental (redintegrative) activities, we may with profit consider the way in which this instrument evolves in the development of an individual reporter. As any redintegrative process is most easily described early in its history, there is an advantage in choosing for our analysis the acquisition of oral and aural language (speech) in an infant. This is true even though it may be expedient to make use of information not reportable by such an infant, though verifiable by him in his later accounts of what happens under similar circumstances. And we need not dwell long on the development of understanding, since this is seen to proceed precisely as in the case of the dog.

DEVELOPMENT OF SPEECH IN INFANCY

In its early days the human infant, provided as it is with a complex vocal machinery, indulges in random motor acts of vocalization and articulation. These motor activities have three aspects or correlates. They are known objectively in the form of visible changes of the mechanisms concerned, and in this form are accessible to all (including the actor) who can "see" them. In this form they may be graphically recorded and thus *indirectly* observed through these correlated visual effects (kymograph records, photographs, and the like).

The motor activities also result in laryngeal sounds (vowels) and articulations (consonants), in random and varying combination. These are, of course, only correlated auditory events, accessible to all who can hear (including the actor), and they may also be objectively recorded and indirectly studied (as by a voice key, phonograph record, and the like).

But the motor activities also appear as, or are correlated with, very distinctive events known only to the actor or speaker, namely, those tactile and kinæsthetic occurrences which we popularly call "the feeling of the movements." Even a deaf and blind speaker has access to these events, which are denied to his auditors or spectators. We call these kinæsthetic and tactual "perceptions," just as the "heard movements" are auditory perceptions, and the graphic records and

visible changes of position and shape of the tissues are visual perceptions. "Perception" in this sense is only a very general and abstract term, equivalent to "object" or "event." We have, of course, nothing to do with the physical account of the "matter," or with the "vortexes" or the "positive and negative electrons" that may be conjectured as the "underlying basis" of these natural occurrences. But we cannot deny nor ignore the kinæsthetic and tactile events (as the extreme behaviorist insists on doing), for we each encounter similar events in nature, if not identical ones, and others report such events to us.

THE STAGE OF CONTROL

To simplify the complexity of what happens, without falsifying the account, let us limit the analysis to the development of a single linguistic unit, such as the word "water." Among the random sounds produced, through the physical vocal activities, there will often occur a combination of consonant and vowel which we may represent by the letters *wa*. This sound may be repeated or prolonged. If either occurs, we have a situation precisely like that of Pavlow's dog. The initial syllable "wa" is somewhat modified (as in loudness or quality) by the new stimuli (kinæsthetic and auditory) which it occasions. The modified continuation, which we may represent by "waw," is a consequent of a complex antecedent, involving:

(*a*) The initial organic stimulus.
(*b*) The heard sound "wa."
(*c*) The kinæsthetic events.

Thereafter any one of these, or some detail closely like it, will tend to arouse an incomplete duplicate of the original vocalization. The sound "wa" alone, as when made either by the infant or by a bystander, will tend to produce vocal activity resulting again in some such sound as "wa," "waw," or "waw-wa." The infant is now, by virtue of a simple redintegrative activity, likely to give such a sound to anyone who says to him "wa," or "waw-waw," or "water."

THE STAGE OF UNDERSTANDING

When this stage is reached the zealous bystander "holds up a glass of water" in the field of view, and urgently says "Water! Water!" To this total situation the infant responds, as before, by producing some such sound as "wah" or "waw-wa." After a few such occasions, under the general redintegrative law, the seen glass of water alone will touch off the ejaculation "wah" or "waw-wa." With subsequent growth and training this sound will be refined to the approved Bostonian "wawtah," and the infant has "learned the name" of the object.

He will thereafter practice this name with glee upon every effective occasion, vivaciously "naming" every object "waw-wa" that even remotely resembles a glass of that substance. To the word "water" he will give, incompletely, such excited movements as he has otherwise come to make to that cooling drink itself. He has now reached at least the stage of understanding if not that of effective use. This speedily comes, in something like the following fashion.

THE STAGE OF LINGUISTIC USE

When thirst comes, it is known to him as a unique event (organic sensation) and to outsiders as an objectively describable correlated state (of his mucous membranes). When thirsty he is given water, and feels keen relief. Meanwhile he sees the water, probably hears mother say, "Wants water," and undoubtedly gleefully exclaims himself, "Waw-wa." This is the first step.

Shortly the thirst itself, when it occurs, is linked up with the exclamation, just as the Irish terrier's sitting posture was evoked by his various occasions of need. Such exclamations are hurriedly responded to by solicitous bystanders, and the use of the word as an instrument of demand is established. The word (heard or spoken) may now be employed as a medium of communication, either in *understanding* others, or in *naming* (describing) an object seen, or in *narrating* an

event observed, or in *controlling* the activity of others who have also acquired the use of this word.

The situation as described is surely much oversimplified, even as an account of the development of a single word. For one thing we have ignored the rôle of mental images, and have not considered the value of the kinæsthetic impressions. Thus there is no reason to doubt that the infant may have "images of water" aroused by his thirst, and may name these images, thus appearing to "prescribe" the cure for his complaint. And we have given no account of the great importance of such items as inflection, accent, accompanying gestures, or of the very significant rôle of concurrent or contextual verbal elements and of syntax relations as these occur in phrases, sentences, and connected discourse. But each of these in turn, if investigated, would disclose the same general pattern of acquisition—that of redintegrative sequence.

GRAPHIC LANGUAGE

In the case of the individual, graphic language of the verbal form is acquired later than speech. The process here is essentially that third form of redintegrative pattern known as the conditioned reaction. Being already able to duplicate sounds made in his presence, the individual is simultaneously presented with a graphic symbol, say the printed WATER and the spoken sound "water," to which situation he responds by making the same sound. With practice the visual pattern (printed word) leads to just such consequents as formerly followed the heard word plus the seen pattern.

Whether this response be a movement, a feeling, an image, a posture, or the production of another word, its occurrence constitutes "the understanding" of the printed word. Thereafter, even partial features of such a word, its general shape and "word form," its initial or prominent letters, its length, and so on, may lead to such understanding. Incomplete glimpses of word features suffice for the purposes of ordinary reading, especially of familiar material. And, of course, in ordinary reading, each word, as a detail of former contexts,

is determined in its potency also by the potencies of other words occurring with it in the sentence or on the page. Thus reading for understanding comes to be not responding to isolated words, but to word groups, in the light of numerous attendant circumstances and constellated features. A given word, as the word "subjective," invokes different consequents in different settings.

Even in the more or less conjectural historical development of written and printed language, the redintegrative basis of communication may be discerned. Something like the following stages seem to be indicated by a study of the history of graphics. First comes, of course, some object or situation itself. For it there is substituted some portion of itself, as an imitative sketch or drawing. This imitative picture is shortly reduced to an outstanding outline, as of shape, conformation, number of points, and the like. The outline drawing in turn gives way to conventionalized forms in which only certain significant features of the original survive, a curve, a number of lines, a spatial relation, variations in size of marks and areas.

These conventionalized pictograms, originally standing for complex situations, as units of discourse, give way to composites of more elementary designs, each with its own standardized significance. Variously combined and further standardized, these constitute such a graphic language as that of China or Egypt. Still later, alphabets are devised, which involve sets of standard graphs, each corresponding to some element of spoken language. Such an alphabet is thus not a direct development of graphic forms but an imposed correlate of speech. But in all these cases the procedure is either that of the substitution of some part for a larger whole, or that of stimulus substitution. Both these processes we have seen to be forms of the redintegrative sequence. Through them, and depending on the way in which the learning occurs, written or printed words may become the direct symbols of things and situations. Ordinarily, however, such written or printed words are symbols of symbols; that is, they are visual surrogates or substitutes for words as heard or spoken. In shorthand another shift is added. Special marks become signs of

printed words, which are in turn signs of audible sounds, which are in turn surrogates for more elaborate contexts.

LANGUAGE IN HUMAN INTERCOURSE

The great significance of language for human intercourse is obvious, but such an account of its psychological development has many implications not often popularly realized. For one thing, it illumines the whole procedure of science and even makes its contribution to epistemology, the general theory of knowledge. We may illustrate this significance by briefly indicating its bearings on the procedure of the science of psychology.

Since language is a medium, the words I use to denote such natural events as I may report are the same as those used by others for their own reports. Others may thus testify concerning events quite inaccessible to me. But their words are understood in terms of those of my own experiences for which the same words are used. They may evoke in me postures, feelings, acts, mental images, and other words appropriate to the situations and events which they "represent," and of which, as symbols, they are fragments.

Thus I may be thrilled by another's eloquence, stirred by his narrative, intimidated by his threats, or may consistently translate his ancient documents. Edmund Burke pithily summed up nearly the whole of psychology when he wrote that "words are in reality but mere sounds, but they are sounds which, being heard on particular occasions, produce, whenever they are afterwards mentioned, effects similar to those of their occasions."

LANGUAGE AS A PSYCHOLOGICAL INSTRUMENT

Psychologists, engaged in part in the study of subjective events, thus seek to compare such occurrences as are reported by different observers, but not by all. The understanding of such reports is determined most of all by the subjective events known to the investigator himself. Since such reports and

interpretations can seldom be put to the pragmatic test of public agreement, there is always likelihood of error. Training in introspection is resorted to in order to reduce this likelihood. Such training is not merely practice in the close observation of private occurrences, although it is in part this. It is also a matter of developing a common terminology on the part of an active group of reporters.

The subjectivity of such events as pains, images, auræ, synæsthesias, feelings, thoughts, and the like, may arise not only from the actual variability of such occurrences and the instability due to their redintegrative mode of production, but also in part from the difficulty of developing a precise medium of communication for matters of such privacy. Nevertheless, just as geographers draw maps of lakes and rivers they have never personally inspected, psychologists must refuse to be misled by those easily discouraged enthusiasts (extreme behaviorists) who gladly repudiate difficult tasks in favor of easier and more publicly acclaimed achievements.

ADVANTAGES AND ERRORS IN LANGUAGE

In conclusion we may indicate briefly various contributions which the use of language makes to the work of science. Language is for one thing a useful instrument of analysis. Names may be given to inseparable though distinguishable features of a context, and these aspects thus made the subject of consideration in ways which they would otherwise resist. This is both an advantage and a source of error. On the one hand, it facilitates comparison and generalization, on the basis of even slight resemblances. On the other hand, it invites always the treatment of the verbally indicated features as if they were actually as well as verbally independent. Wholes may thus be verbally analyzed into parts which lose their most essential properties by such dissection.

Linguistic elements (words, numbers, all kinds of symbols) may be readily manipulated, juxtaposed, concatenated, in narrow limits of time, space, and effort. As symbols they thus permit a short cut to observation and experiment. For

many relationships between things may be discovered by studying the implications of their symbols. Thus one may choose among various alternatives, arrange a banquet seating plan, select a place of residence, declare war, levy taxes, or overthrow a monarch by the effective use of linguistic surrogates for actual acts. "Paper and ink," wrote Bradley, "cut the throats of men, and the sound of a breath may shake the world."

The use of an encyclopedia or a map neatly illustrates this momentous way in which linguistic surrogates enable judgments and reveal relations involving facts which the actor never actually confronts. In their later stages many sciences, dealing originally with face to face materials, come to be preoccupied with highly abstract symbolic manipulations. In the account of mental imagery we called attention to its early displacement by linguistic symbols. The present topic shows some of the reasons for this displacement.

On the other hand, the scientific use of language, especially of verbal language, has its pitfalls. One of the commonest errors is the supposition that natural events are as simple and discrete, as piecemeal and discontinuous, as the explosive words which we use to denote them. We have already seen how the dichotomizing tendency of speech led to the erroneous picture of nature as a split world, with a sharp cleavage between such extremes as sick and well, subjective and objective, mental and physical. Had this earth not been occasionally shrouded in darkness, gesture language might have developed instead of speech. Continuous transitions might then have been explicitly recognized by gradations of gesture, as in rate, vigor, or scope. It is difficult to estimate the degree to which the intermittence, discreteness, and explosiveness of oral speech sounds have influenced man's description of nature.

OTHER INTERESTING LINGUISTIC TOPICS

If space permitted it would be interesting to consider many other features of language. Especially inviting are the study of the understanding and use of linguistic signs by creatures

other than human organisms; the genetic course of language development in the maturing individual; the very curious psychological and structural changes that occur in the history of a language; the revelations which established linguistic usages and forms give of the psychology of their creators (why, for instance, has English no word corresponding to "hearing," as "reading" corresponds to "seeing," and no collective word like "audience" for a group of spectators?); the influence of language on other mental activities; the learning of foreign languages by adults; the nature and development of other than verbal languages (the number system, for example); and especially the elaborate development of mathematical, statistical, artistic, and musical symbolism.

Such topics are beyond the scope of this general survey. But the subject cannot be abandoned without assuring the student of language (rather than of languages) that in this field one finds in its clearest possible form the characteristic of those activities we call mental. The psychology of human language, the crowning achievement of man, affords an approach to the very framework of those redintegrative activities which we call mind. Language development, the technique of symbolism, is one of the most direct indicators of that general level of capacity which we summarize by the word "intelligence."

LINGUISTIC ILLUSTRATIONS OF REDINTEGRATIVE LAWS

In an earlier chapter there was presented a summary of numerous general redintegrative laws. It may be useful now to refresh our memory of these important psychological principles, originally given in connection with the account of the conduct of a soldier. They were later illustrated also by the more specific results of the conditioned reaction experiments, and may now be neatly demonstrated in the effectiveness of linguistic symbols. Enough random instances may at least be cited to indicate the wide application of these general laws to mental activities.

1. *Identical events are those belonging in a given class.* Thus "the word yellow" is not any persisting identity. It is

instead a class of patterns (visual and auditory) occurring variously in space and time, any one of which is equally applicable to the sensory quality evoked by ochre pigment, and any one of which may arouse imaginal yellows, synæsthesias of tone, characteristic feelings, further words, and other motor changes in a given beholder.

2. *Consequents may follow fragments of former antecedents.* Thus a word itself is "understood" only in so far as it is an effective detail functioning in the place of former antecedents. And parts of such a word, as in ordinary reading and conversation, may suffice to evoke acts similar to those that would have followed the more fully presented word. Abbreviations, for example, may be almost as effective as fully spelled words (Mr., Col., etc.).

3. *The completeness of a redintegrated response varies with the completeness of its stimulus.* The interpretation of a full word is likely to be more prompt, confident, whole-hearted, and accurate than are responses to abbreviations and to imperfectly spelled or poorly written words. The Irish terrier's response is more certainly and more fully secured by two cues (verbal command and raised hand) than by one of these alone. What we call "full instructions" differ in this way from "brief indications"; the verbal or other cues more fully represent the original contexts to which they owe their potency.

4. *Some of the details of an antecedent context are prepotent.* Accent and inflection are more important cues in verbally controlling the dog than are the particular vowels and consonants employed. Some parts of a word are more "determinative" than others. Thus the initial and early letters are often more important than the later ones (compare "fath—" and "—ther"). In keeping with this, errors in spelling are more frequently found in the final half than in the initial half of a long word. Again, some letters of a given word are superior in cue value to other letters (compare "h-pp-n-ss" with "-a- -i-ess"). The shape of a printed word is a more effective partial cue than is its size or length. Thus *b o y* and *g i r l* are discriminable readily by their respective word forms,

but *m a n* and *w o m a n* are not easily recognizable merely through their different lengths.

5. *The potency of a given detail varies with many determinants,* such as temporal position, context, recency, concurrent details, and the like. Illustrations are abundant in the effectiveness of language symbols. The compound words "up set" and "set up," "under stand" and "stand under," lead to different consequents. Although their verbal elements are the same, the positions are different. "Fast" may be the equivalent of "moving rapidly," "unable to move," "go without food," "spend lavishly on food and revelry," and so on, depending on the context in which it is used and on its concurrent details. The word "on" has different meanings, depending on whether it was taught by a French or an English teacher. And it is easy to see how the meaning of a given word varies with the accompanying inflection, gesture, or with earlier words in a sentence (as in "run fast" and "hold fast").

6. *A detail's momentary potency is a complex resultant of all its effective determinants.* The effect of the spoken word "Fire!" is complexly determined by the joint influence of such various items as the tone in which it is spoken, the concurrent gestures of the speaker, preceding words in the discourse, past contexts in which it has occurred, visual clues relating to the present environment, and so on. No one of these, considered alone, is likely to give a sufficient explanation of the particular consequent of the use of the word on a given occasion.

7. *Stimulating details may reënforce or inhibit one another.* Thus the dog, as we have seen, responds more vigorously and completely to "Stand up" plus "raised hand" than to one cue alone. These two cues are compatible, lead in the same direction, and are mutually facilitating. If told "Sit up" and also given the "raised hand" gesture (meaning "Stand up"), the two mutually interfere with the definite behavior of the dog. The pack animal who is simultaneously stimulated by a verbal signal for "left" and a rein signal for "right" presents a typical picture of interference or inhibition. The outcome of such a combination of cues may vary with such simple facts as the relative vigor or the slightly different time order or duration

of the two cues, or the different specific degrees of effectiveness due to past trainings in the two cases.

8. *Each consequent reflects the total past of the system in which it occurs.* Thus the use of such a word as "water" by the infant is a final resultant of the hereditary speech mechanism, the random babblings, the auditory, kinæsthetic and visual experiences, the satisfied thirsts, the ministrations of bystanders, other experiences with words and with bystanders, and so on indefinitely. And the older the individual grows, the more complex will be the experiences, the information, the activities, that bear upon the use of even a single word or concept. In fact, when the infant becomes a chemist or a biologist, the use he makes of such a word as "water" will reflect a long education, a highly technical scientific experience, and much of the history of human culture.

9. *Some antecedent contexts endow their details with superior instigative potency.* Thus the names for certain things, persons, and acts are learned by the infant with special promptness. Such contexts are in general those called striking, vivid, interesting, emotional, disturbing, satisfying. The infant learns most quickly to "understand the signs" of contexts closely related to his bodily comfort, his feeding, his motor activity, and those which arouse his deep-seated attitudes, such as rage, fear, pleasure, depression.

10. *Stimulus incompleteness may arise through partiality, reduction, and concurrence.* We have already illustrated that mode of incompleteness due to the working of details originally an essential part of the antecedent, under the second law. Concurrence is the name given to that partially described redintegrative situation known as the conditioned reaction, in which the cue is an item apparently arbitrarily introduced into the situation. This is what occurs when the already mastered sound is tied up with the visual appearance of a glass of water. This "added stimulus" also has, as a matter of fact, its characteristic response (eye movement and fixation). But this fact, and that half of the redintegrative situation involving it, were characteristically ignored in our account because of the momentary interest in *speech* rather than in eye movement.

Reduction shows itself neatly in the case of the dog's response to verbal clues. Initially only a loud and snappy "Sit up" would bring him to position. Later a very subdued command was equally effective. Now even a whispered command is understood, that is, obeyed. The energy requirement of the effective cue is thus remarkably reduced, and this reduction constitutes a further redintegrative phenomenon: it is a mode of incompleteness.

11. *Some features of a co-response are more easily redintegrated than others.* The word "Fire!" suddenly shouted at one, evokes at once the characteristic bodily attitude of alertness; somewhat less quickly the emotional events known as excitement, fear; and still more slowly such useful protective acts as have been established in connection with this word.

12. *Simultaneous response tendencies combine, producing patterns of compatible features.* When the dog is simultaneously given the two cues "Stand up!" and "Go home!" (the latter being not a word but a pointing gesture) he "tries" to do both. The result is sometimes a sudden retreat, then an erect posture which halts the retreat. Often instead, it is a grotesque combination in which the animal shambles off in a half-erect waltzing fashion. The two response tendencies, if simultaneously prompted, combine as best they may. The surviving features of the two partially incompatible acts represent a net resultant of facilitation and interference.

13. *Both subjective and objective events participate in redintegrative sequences.* The characteristic response to such a word as "Fire!" involves both overt motor changes (observable visually by any number of reporters) and also various subjective events (images, kinæsthetic impressions, feelings) accessible only to introspection. The sound "water" arouses not only objective articulation movements which produce a duplicate of the stimulus, but also visual imagery and kinæsthetic impressions known only to the actor. The speaker's narrative evokes not only appropriate bodily and vocal activity, and objective changes in pulse rate and breathing, in the listeners. It also invokes a rich play of private events accessible to and reportable by the method of introspection only—the sound

of the words, the correlated imagery, the feeling tone, the memories, and so on.

14. *The efficacy of a past context is not due to its reproduction, nor to its unconscious persistence.* Reactions to language cues may be and usually are immediate. Words do not require that, before they prompt appropriate response, their past contexts be revived, even in the form of imagery. Nor when part of a word is effectively understood, need "the remainder" of the word first be supplied or supplemented in any form whatever. The older psychology erred in supposing that such "imaginal supplementation" was even usually the case. The partial clues (abbreviations, word forms, dominant letters) are *at once* as effective *as if* the wholes were there. The wholes then *need not* be in any way reproduced, reinstated, supplied nor "roused from the unconscious." That imaginal supplementation of either complete or partial verbal clues *may* sometimes occur is, of course, true. But this is not necessary and, as in reading poetry, it is often only a handicap to appreciation.

This rather repetitious restatement of the general laws of redintegration has been given for two reasons. On the one hand, it should so serve to refresh the reader's memory of these principles of mental activity that in the discussion of later topics their understanding may confidently be taken for granted, without restatement. On the other hand, their importance and validity is emphasized by the example of the readiness and aptness with which the laws apply to fields quite different from that in connection with which they were first stated. The laws are not merely laws of neurotic conduct, nor of salivary secretion, nor of linguistic understanding. They are the general laws of mental activity, wherever it is encountered. In the future we may make it our business not to demonstrate them as laws but to utilize them in the account of any mental activity that we may be investigating.

CHAPTER VIII

NATURAL SIGNS AND THE PERCEPTION OF IDENTITY

THE NATURAL MANIFOLD

In that total field to which an individual has access, changes constantly occur. What we call the world of nature consists of this course of change, and the inferred processes suggested by it. Features, qualities, relations, objects, sequences, appear and disappear. Nor do they occur in isolation; always they are centers of change on a background of relative stability. With eyes closed, the vague background of grayish darkness is broken up by luminous spots. Lines and clouds of brightness appear, constantly shifting in position and degree, and changing in time. With the eyes open in broad daylight, still more complex patterns and items appear, upon a varied and more complex background. The case is similar with all the other modes or fields of observation—the arrays of pains, pressures, sounds, felt movements, the fields of imagery and feeling, the structures of pattern and relation.

The organization of immediate events is much more complex than this distinction of item from background indicates. Items not only include *qualities* (such as sweet, cold, red); *feelings* (as pleasantness, conviction, excitement), *relations* (as above, together, difference); but such items are variously grouped and patterned into *structures*, objects, configurations, situations. What we call qualities, feelings, and relations may also be compared, one with another, so as to reveal their own great complexity. Thus a pain is not wanting in intrinsic and constituent *attributes;* it differs from other pains in certain of its features, as in intensity, character, voluminousness, duration.

The structural character of the natural manifold is a fact of

immediate observation or encounter. This character cannot be explained, although the momentary form of its organization can often be correlated with other observable or reportable conditions. The flexibility inherent in this organization or integration of nature permits of numerous equally applicable descriptions, but any described natural pattern is discovered, not constructed by the observer. Thus the course of an individual's existence may be divided into sickness and health, or into sleeping and waking, or into play and work, or into life and death. But such distinctions are after all not made but only *discovered* and *selected* by the observer.

Thus prolonged or frequent scrutiny of any pattern (such as a machine) commonly discloses great variety and detail in a previously amorphous or homogeneous field. With experience the motorist constantly discovers new parts in the engine which originally stood out only as a relatively undifferentiated mass of iron. And each newly discovered part, in turn, may with familiarity and closer inspection reveal itself as a complicated system.

As I write I note a vague background of sound, from which emerges conspicuously the soft scratching of my pencil. But now this vague background breaks up. There are noises of trucks, hissing of radiators, rumble of elevated trains, honking of horns, shrill whistles, clanging bells, the gritting of my teeth against the pipe stem, and so on. Each of these, as the noise of the trucks, turns out, if attentively regarded, to contain many components, each of which has its own discernible phases, and each phase its constantly changing attributes, as of intensity, rhythm, timbre, and the like.

To the porter, carrying my trunk, this is a relatively undifferentiated object, characterized only by its size, weight, and handles. To the customhouse inspector the trunk exhibits a much more highly patterned structure. Its contents stand out with dismaying distinctness, each unit characterized by its market value. To the laundress or tailor, in turn, each of these unitary garments is an integrated pattern of smaller details. While to me, the owner, each frayed spot, stain, and moth hole has a unique individuality and a precise history.

It is sometimes asserted that the structural features of nature are not merely discovered, but are actively constructed in terms of human purposes. This is to overstate the flexibility of natural organization. Our development of names, our conventional recognitions and categories, and the divisions of nature with which we are preoccupied at given epochs are, to be sure, contingent on our current hopes and habits, on our needs and aims. Many natural patterns go unnamed and undescribed until occasion makes their discovery important. But only in idle dreams or in a dramatically overstated philosophy are the patterns of nature freely constructed. Such an illusion is readily adopted by the unwary, because the rich integration of nature vastly exceeds the limits of those descriptions which a worn out philosophy or a decaying culture may have laid down. Thus one who should maintain that my trunk and its contents were really organized only in terms of the tariff regulations would merely be suffering from a political obsession. But that there are natural limits to the freedom of such organization, my tailor unfalteringly assures me.

It is, of course, a mistake to suppose that natural objects can always, if ever, be actually dissected into their components, even quite aside from the damage thus done to their integrity. The components are what they are by virtue of their mutual relationships in the whole pattern. A dog may be described as "made up" of head, tail, legs, body, and internal organs, but a mere assemblage of such items does not comprise an animal, and the isolated structures are no longer organs. A square may be analyzed into the sides which bound it, but not every assemblage of four lines constitutes a square. The square is more than its parts; it is these parts in relation, and in such an organization there appear new features (angles, enclosed space, stability) which do not characterize lines. A mere array of tones does not constitute a melody, for this is an orderly tonal structure. Similar tones, variously arranged, may become very different melodies. And melodies have properties which tones do not possess, and which cannot be discovered by the closest scrutiny of "tonal elements." Everywhere in nature such facts are illustrated.

ANALYSIS AND SYNTHESIS

Nature thus appears as a manifold, variously structured. That in this manifold diverse features or items may be discerned, named, compared, correlated, is the basis of all observation and the presupposition of science. Science is concerned with the faithful description of this manifold and with the determination of the various interrelations of such items and patterns as occur. In this endeavor it most often proceeds by analysis, that is by closer and closer inspection. In this way, in a large complex, the constituents are identified and named, and description and communication are simplified; often, indeed, oversimplified.

Thus anatomy approaches that complex structure known as an organism and straightway analyzes the organism into its organs, their functions, and interdependencies. Organs are in turn analyzed into tissues, these into cells, these into chemical compounds, these into their molecules and atoms, atoms into electrons and protons, and so on indefinitely. And many sciences are especially occupied with the quantitative and relational aspects of nature, and with their measurement, rather than with the features of quality. Thus physics ignores the composition, origin, and history of a moving object, regarding only its trajectory. Chemistry overlooks the beauty and the taste of a compound in its preoccupation with quantitative analysis.

Practical activity, on the other hand, as in art and industry is more likely to be engaged in "production" or synthesis. From "raw materials" it fashions more complex structures. From lumber, nails, cement, it constructs houses, sidewalks, bridges. From lines, colors, forms, it fashions mural decoration and portrait, and from varied tonal elements and relations it creates symphonies.

That industry must often first isolate its ores from their conglomerates is, of course, true. But the distinction between the general synthetic activities of industry and the analytic procedures of science is nevertheless instructive. For the task of science is description, and description is facilitated by the

reduction of complex things into their constituents. Since in such reduction the "elements" become themselves individually or abstractly regarded, science is in a sense a transformation of nature. Its description of a natural pattern falls ordinarily at least a step short of the concreteness which natural events have in their immediate occurrence.

From the "parts" as described it is seldom possible to reconstruct the original organization, for as *parts* they lack something characteristic of the total structure. Thus in the analysis of space into points, the continuity so characteristic of space is violated. In the analysis of an organism into tissues, the "organism as a whole" loses its original and unique individuality. The analysis of an act into its constituent steps gives a mechanical sum in which the living character of the movement does not clearly appear. The parts resulting from an analysis thus become at once something less and something more than they were as moments of an integration.

NATURAL STRUCTURES

We mean by nature more than appears at any one moment, for "time is of the essence" of natural processes. Thus a melody is essentially a serial or temporally extended object. It cannot all be heard at once. Even so simple an object as a pain is more than the pang of a given instant: the pain has its life, its duration. The observation of the moment is incorporated with past moments, whose events, no longer present, are nevertheless represented by present changes or by present signs. This temporal course of events and the temporal relations which they exhibit (simultaneity, priority, succession, duration, and the like) constitute one great aspect of nature, which, when we abstract it from other aspects, we call Time. But temporal relations are part of the intrinsic "stuff" of nature, not frames within which events happen, nor spectacles through which we view them. We encounter temporal relations just as we encounter colors and odors, pains, and aches, intensities, and resemblances. We should be as justified in assuming an absolute similarity, within which oc-

curred the concrete and actual resemblances of life, as to suppose an absolute time, within which occur life's actual durations and intervals. Psychologists have always been impressed by the "relativity" of time, as also of quality, of intensity, of feeling tone. Modern doctrines of the relativity of time and space tell us nothing new about nature. Instead they serve only to reveal the contradictory features inherent in certain widely adopted fictions once supposed to stand under and support the flow of natural phenomena.

A melody, as we have seen, is a temporally organized pattern, a relational incorporation of momentary tones. And a pain is also a temporal configuration of momentary pangs and throbs. There are also patterns of the type called spatial. Thus a triangle is a spatially organized complex of locally different points, lines, areas. A rainbow is a still more elaborate structure, a spatial configuration of brightness and color. The melody and pain, the triangle and rainbow, as complex structures, are commonly called objects.

Objects may also be the incorporation of items in relations of the numerical order. Thus a pair, a dozen, a sum, more, less, and the square of nine, are symbols used to designate such numerically constituted structures. In addition to the common modes of relation illustrated by time, space, and number or order, there are also numerous others. Thus there are the biological relations of those individuals constituting a family, and such modes of relationship as those encountered in logic, in politics, in æsthetics, ethics, chemistry, physiology, and mechanics.

The most familiar objects of nature are even more complex than those we have used as illustrations, since they are patterns or incorporations in which all these modes of organization are involved, and often include qualities from diverse sensory fields and items reported by different observers. Thus even so relatively simple an object as a pencil is just such an elaborate incorporation, involving temporal, spatial, numerical, and other relations, and a variety of qualities, all in complicated intercorrelation with other objects and with the social reports of fellow creatures.

Even a momentary "appearance" of a pencil is a fairly complex pattern of qualities, relations, and correlations. There are the temperature, smoothness, resistance, and the size and shape which involve the distribution and organization of these qualities as the pencil appears in tactual form—a tangible object held in the hand. Correlated with other events, such as finger movements, these patterns rapidly shift and change. There are also other correlates, such as the fairly elaborate visual pattern which appears in connection with such events as looking toward the hand, the visual experiences of color, size, shape, shading, design, and direction.

The pencil, even when not "in use," is thus a complex integration and correlation of simpler objects in relation. Even the visual pattern varies with the tactual changes occasioned by (correlated with) the moving fingers. It is this intimate correlation of events that constitutes the "one-ness" of the object. The name "pencil" is applied to that total configuration, a temporally extended, numerically ordered, spatially variable series of events, chiefly visual and tactile in quality. The complete pencil, as it occurs in nature, is just this complex organization of events, the complexity of which is even greater than our account suggests.

For the pencil, as an incorporation or pattern of natural events, includes also previous quality-in-relation clusters, which date back into yesterday. The sights and feels of yesterday are in various fashions correlated with similar events of to-day. I "find" the pencil to-day where I "put" it yesterday. The pencil, like the pain and the melody, is thus an organization of events in time as well as in space. This organization is, moreover, sufficiently loose to permit of all those "changes" which the pencil undergoes, as its color changes with age, its length varies with use, and so on. The pencil, as a natural object, or structure, comprises all these manifold occurrences as well as the various events which others report and for which they may use the same name. The pencil is thus not merely my momentary sensations as I "see" it (although it includes these), nor is it an unchanging "chunk," enduring out of relation to other events, or in an unobservable,

supernatural form. Even when not "present" to me, its subsequent appearance is closely related to many of my current experiences.

Thus I "find" it by changing my present location, through movement. And the movements involved are linked in a continuous chain with the location at which the pencil again appears. Just as the melody embraces tones that have gone, and others yet to occur, so that incorporation which I call a pencil includes past episodes, episodes reported by others, and episodes which may yet occur or be reported. Nor is the pencil any ineffable thing behind or in addition to these complex occurrences: the pencil *is* these events, in their totality and interrelations. My "sensations," referred to the pencil, are not mysterious subjective "pictures" or "duplicates" of the *real* pencil: they are part and parcel of it. The spatial and temporal aspects of the pencil are neither neutral frames within which the pencil "exists," nor are they "mere conscious states," severed from the pencil but dependent on it. Instead, these also are intrinsic features of that primary but complex object, the pencil. Sensory quality and relationship are not trivial psychic whispers which mean or point to the pencil, without being it. The color of the pencil exists in that one natural realm in which occur also its position, its extension, its mass, and all its other constituent features.

A perverse philosophical tradition, which has infected classical psychology also, insists that primary qualities (by which it means extension, resistance, duration, and the like) exist "outside the mind"; whereas secondary qualities (such as color, taste, pleasantness) exist only "in consciousness." The latter are supposed to be the "effects" produced on mind by the former. This distinction is only a naïve recognition of the statistical fact, already indicated, that some natural events are consistently and others discrepantly reported. Actually, instead, my color sensations, say of the rainbow, "exist" wherever I, as a matter of fact, find them, since "whereness" is only a correlation with other observable events. And I find them in the "outside world," whatever that may mean.

They are at least outside my body. My body and the

colors of the rainbow are found in the same world. They are outside one another, just as each is in turn outside many other things. If the rainbow be located not in nature but in my consciousness, then my body is also there, which allocations land us in the nonsense world of "solipsism" and "subjective idealism." The only hope lies in the honest recognition that natural events exist wherever they are found, by whomsoever they are observed, and with whatever statistical consistency they are reported, namely, in the realm of nature. The *seen* pencil is the *real* pencil, although the visual features do not by any means exhaust it.

THE PERCEPTUAL PROCESS

It is at once apparent that although the name "pencil" is given to a very elaborate incorporation of natural events, the reapplication of the name need not await the total recurrence of all these related items. A very limited and partial feature of this total incorporation, occurring without the others, suffices to provoke the name. The "feel" of the pencil in the resting hand touches off the verdict "Pencil!" The visual pattern, or one even remotely resembling it (as in the case of "a pencil of light rays") is similarly effective in instigating such consequents as would appropriately follow the larger and more complex configuration.

And this is true whether the consequent be the verbal exclamation of a name, or the act of pointing a finger, or the rise of feelings of guilt or joy or wonder, or the occurrence of "mental images," as of marks on a paper sheet. Whenever such consequents are redintegrated by a partial feature of that complex object which we in daily life call pencil, we have a characteristic act of perception, a mental rather than a physical sequence. Perception is, therefore, a typical mental or redintegrative sequence, in which an act or verdict or other event is dictated by a partial feature (clue, sign, symbol) of a previous complexity.

As we have seen, such an activity underlies or describes the use of language of all kinds. Gestures, printed pages, spoken

words, diagrams, and varied signs instigate consequents appropriate to the larger situations of which they have been partial features. The "interpretation" of such cues or signs is, therefore, a typical perceptual activity. We might develop our whole account of perception through reference to such processes as reading with comprehension or listening with understanding. But since we have already exploited the field of language, with its facts of substitution and significance, we may more profitably turn now to other fields, in which perception is the interpretation of "natural signs," rather than of the arbitrary signs of language.

THE RECOGNITION OF OBJECTS

Much of perceptual activity, especially in the case of human beings, consists of the *identification* of objects that are only partially present. Upon the occurrence of a definitely patterned series of sounds (footsteps) I promptly report, "There comes the postman." What *observably* comes is much less than the complex event which I thus report. But the occurring detail is part of a larger context. In the past I have heard just such a characteristic sound pattern, noted the clattering of shoes on the board walk, seen a visual pattern approaching (enlarging and exhibiting more and more detail), received the letters extended in the hand of the postman, and learned that the name of this complex set of events is "the arrival of the postman." Now the auditory pattern alone, which is but an organized shift in my field of hearing, leads to an exclamation (or other consequent) appropriate to the larger context. I hear the sounds, but I perceive the postman.

Just what the consequent may be is unimportant for the process we are describing, as long as it is appropriate to the larger context. Thus the sounds may provoke a mild feeling of curiosity, arouse excitement, evoke visual images of the postman's gray figure, bring me out of my chair and hurry me toward the door, lead only to the verbal exclamation "The postman!" or may even invite only a knowing shrug of the shoulders with a brief glance in the direction of the street,

and so on indefinitely. The consequent may be observable by others or may be reportable only by the actor, may be objective or subjective.

In any such case we are, nevertheless, dealing with perceptual activity, although it may be convenient and useful to distinguish the various types of consequent. Thus the images and verbalizations we may call *symbolic* consequents; the consequent is a symbol for or a report of the antecedent. The feelings we may call *affective* consequents; they are highly subjective and individual, and accessible only to the introspective report of the actor. The locomotion, the shrug, the visual fixation, are *postural* consequents; as bodily activities they are often said to comprise the behavior of the individual; they are, at least in theory, open to the inspection and consistent report of numerous observers. The actual consequent may be a combination of all these forms.

The occurrence of such consequents is what we often call the "recognition" of the object, and it is a suggestive word. Recognition is strictly a re-cognition, but it is typically a cognition or knowing based on slight cues and partial details of former complexities. The perception of a natural event is thus a recognition of it. Such an act clearly follows the redintegrative paradigm. It involves first of all a prior sequence, in which an original antecedent and its consequent comprised a forward-moving procession. It involves the subsequent occurrence of a detail, in class with some partial feature of this original antecedent context or co-stimulus. And it involves the duplication, often incompletely, of the original consequent, or co-response, whatever its nature.

The laws of recognition are the general redintegrative principles. Recognition is more certain (complete) when the cue approximates a complete recurrence of the original; its certainty varies with the completeness of signature. If I hear the footsteps and also see the gray uniform, my recognition of the postman is both more prompt, more sure, and more often confirmed. Some cues are, moreover, prepotent; thus the uniform alone is more reliable than the footsteps alone. The recognition will vary with the time interval elapsing since

the original experience, with the various other contexts in which footsteps and uniforms have figured, with the compatibility of the cues provided, with the influence of concurrent stimuli from other sources or contexts, with the frequency of the occurrence, and so on.

All the laws considered in connection with the arousal of fears, the salivary secretions, the evocation of imagery, the synæsthetic and æsthetic feelings, and the understanding of language, apply with equal suggestiveness to the process of perceiving or recognizing natural objects. And just as there are also special laws for such particular consequents as fears, salivary secretions, and understandings, and for each type of cue, each setting, various species, there are also special laws applying particularly to the various circumstances and materials of recognition and identification. Thus the recognition of places, of persons, of jokes, of sounds, of plants, of social situations, and so on, may require separate experimental investigation. For in any given natural sphere there are special as well as general redintegrative laws. As the word is commonly employed, recognition shows many varieties, depending on the nature of the consequent, of the original context, and of the instigating detail.

MODES OF PERCEPTION

In a familiar form, recognition or perception consists in the arousal of an appropriate *name* by some instigating detail. I am said to recognize a person, a tune, a disease, a place, an animal or plant or tool, when I can correctly call it by name. Since many other activities are often effectively linked up with names, the naming response is often taken to imply the preparedness or capacity for other relevant consequents. A common educational fallacy consists in an undue confidence in such a linkage, and rests content with the teaching of names.

In another common form, recognition or perception applies to the instigation of relevant consequents quite other than naming. Thus one recognizes his betters, his duties, his status, his danger, his opportunity, and so on, not by applying to

them a verbal synonym, but by adequate adjustment of emotion or of conduct.

The form of perception also varies with the scope of the original setting to which adjustment is made or expected, and with the limitations of context in which the detail is to be considered. Thus, under that general form in which the consequent is a name, there are various levels of recognition. An approaching figure may be recognized (perceived, identified) at a great distance, as "an animal." As it comes nearer, and more details are presented, it is successively and with increasingly specific reference, recognized as "a human being," "a woman," "a white woman," "a neighbor," and finally as "Mrs. Smith." Completeness of recognition thus varies with completeness of stimulus, and all these identifications were correct, but adequate to different limits of the context perceived.

This succession or variety of identifications may be represented by the following arrays of verdicts or names, in which the increasing specification, as the object approaches, may be said to constitute fuller and more complete perception:

Distance	*Verdicts of Perception*
5 miles	an animal
3 miles	an animal, human
1 mile	an animal, human, female
⅓ mile	an animal, human, female, white
100 yards	an animal, human, female, white, familiar
10 yards	an animal, human, female, white, familiar, Mrs. Smith

In this account we have, while admitting degrees of completeness in perception, spoken as if each stage were an all-or-none event. As a matter of fact the completeness of perception is a function not only of such stages but also of its confidence. A recognition is confident when it occurs promptly and free from the inhibition of alternatives. Such a result depends among other things on the number of details presented, on the number of contexts in which such details have participated, on the time intervals and frequencies of encounter.

Thus, to take the above case, suppose it were required not to identify the species, sex or color of the approaching figure, but as soon as possible to give its "name." Names might be aroused by the first appearance of the figure, dictated by the general knowledge of possibility and likelihood. But several would clamor for utterance with more or less equal pressure, or if one came more readily, the pressure of its incompatible rivals would retard and diminish its occurrence. As the figure drew nearer the claimants would decrease in number, but at any point some one name might be delivered if the demand were reënforced by the request of the experimenter or the urgency of the occasion.

But until the final stage the name would be assigned tentatively, with reservations and qualifications, not whole-heartedly, with varying degrees of assurance, falling short of, though increasingly approximating, perfect certainty. Perfect assurance is the verdict of complete perception. Anything less would imply guessing, inferring, judging, as the terms are commonly used, and as we shall later analyze them. We may represent this continuous gradation of perceptual confidence by the following stages, bearing in mind that the discrete steps represented are arbitrary and violate the actual continuum of assurance:

TABLE I

GRADATIONS OF CONFIDENCE

Distance of the Figure	Names Aroused, the One Italicized Being Given on Demand or Urgency	Degree of Confidence, in Per Cent
3 miles ...	Mrs. Jones, *old man Brown,* Captain Blank, Al Rhodes, Mrs. Smith, Tom Jay	10
1 mile	Old man Brown, *Mrs. Jones,* Mrs. Smith, Tom Jay	25
⅓ mile ...	*Mrs. Smith,* old man Brown, Mrs. Jones	50
100 yards ..	*Mrs. Smith,* Mrs. Jones	75
10 yards ..	*Mrs. Smith*	100

Experiments show that, within an individual's reports of a given material or field, high confidence commonly certifies greater accuracy; that is to say, under ordinary circumstances,

confident perceptions are concurred in by others or persisted in by the individual. There are, of course, exceptions to this rule, as when subsequent events bring new evidence, or attention is directed to details at first ignored. But it does not follow that between or among individuals confidence is a reliable sign of trustworthiness (general or subsequent agreement). For the various *degrees* of confidence may be differently defined by different reporters, who also may be differently disposed to the potency of the clues available. Just such individual differences we have also noted in the fear of sounds, the salivary secretion of dogs, synæsthesias, imagery, and the understanding of linguistic symbols.

EXPERIMENTS IN RECOGNITION

Experimental inquiries into perception are usually more restricted in scope than the situations we have described. Thus, in typical investigations, the subjects are presented, on a given occasion, with a specially chosen set of objects, such as photographs, car cards, colored designs, tonal patterns, clangs, and the like. On a later occasion they are required to recognize these materials, commonly by selecting them from a larger array, some of which were not in the presentation series. The subjects may also be required to indicate in each case, by some convenient code, their degree of confidence. Or they may be requested to describe the act, as by indicating the effective cues, noting the nature of the consequent, describing the course of the process or sequence. Records may also be made of their speed of decision, the number of errors, the type of error, individual differences, the influence of various repetitions of the presentation series or of its length, the effect of varying the time interval between presentation and test series. Or various misleading or changed materials may be introduced into the test series in order to investigate objectively the relative importance of different cues, their mutual influences, and so on.

In such an experiment the act of recognition is arbitrarily restricted. Thus it is of no avail for the subject to recognize

the total object as, say, a car card, or as a rectangle or a sheet of cardboard or an advertisement or as a colored or a near or fragile or harmless thing. All these (in whatever form the consequent) are recognition. But the experimenter ignores them, and since they are equally applicable to all the members of the test series, regardless of their relation to the presentation series, they do not influence the score.

The experimenter, instead, requires that the cards be recognized only in their feature of having appeared or not appeared in the presentation series. Not "Have you seen anything like it before?" but "Did I show you this in the presentation series?" is the question. Only if the materials in both series are entirely novel (which is probably never the case) are the influences of contexts earlier than the experimental presentation completely avoided. The special results of such experiments, therefore, apply only to the particular materials and setting, as we found also to be the case with language, imagery, synæsthesia, salivary secretion, and neurotic symptom. A few representative results may be cited to illustrate the experiments concretely. In such experiments we are investigating that mode of perception which is especially concerned with the relations of identity, difference, and similarity. In later chapters we shall be more concerned with the recognition of social, temporal, spatial, logical, and other typical natural situations.

SUBJECTIVE EVENTS IN RECOGNITION

When skilled observers are employed, the report of the subjective events occurring in a fairly simple act of perception is found to be much more complex than the objective appearance might suggest. Several investigators have reported series of such introspective accounts, in which the subjects were required to recognize (identify) such objects as odors, type faces, musical compositions, and letters of the blind alphabet. We may quote two typical reports, by way of illustrating the sequential aspect of this act, and the varied nature of the consequents which may be involved.

In the first case, the subject listened to the playing of an air which had previously been learned to have a given name. The musical composition presented in this particular case was Tschaikowsky's "Overture 1812." The subject was not only to identify the air but thereupon to give a complete account of the process of perception. This account was as follows:

When the music first began, I was aware of the character of the music as such—it was fast and confused. I was conscious, too, that my attention was not very alert at this time. The next thing I perceived was the beat of that rhythm, this perception seeming to consist in an ability to anticipate the note in auditory fashion. A slight feeling of pleasure accompanied this. Then suddenly I was aware of the *Aufgabe* (task), which seemed to be present as an effort of keener attention. Several successive visual images now came in; the first was the word "Tschaikowsky"; next the word "Danse Trepak," accompanied by a fleeting visual image of a Russian dance. There was now an increased familiarity which seemed to be associated with the image of a piece of paper localized off in space, but no word was perceptible on it. I thought I knew what the name was, however, this being present in a faint visual image of "Tschaikowsky" off in the fringe of consciousness, located at the left. I was conscious of kinesthetic sensations in the region of my mouth which was opened as if to say "O." Then suddenly I found myself pronouncing "Overture," and immediately "Overture 1812" appeared upon my visual image of the piece of paper. My reaction then followed in mechanical fashion.[1]

In the foregoing introspective account is seen what considerable complexity may be involved in a perceptual act, and how consequents in a given case may lie on all three of the levels we have indicated—symbolic (the words and images), affective (the feelings of pleasure and familiarity), and postural (the attitude of attention, rhythmic activity, mechanical articulation). The following further example illustrates such facts as the occurrence of incompatible alternatives, the grades of certainty, and some of their determinants. The "object" presented was a whiff of ethyl alcohol, which was to be identified.

[1] E. L. Woods, "An Experimental Analysis of the Process of Recognizing," *American Journal of Psychology*, July, 1915, p. 334.

On perceiving the coolness which the first sniff of this produced in my nose, I said "Alcohol." This was in vocal-motor imagery, with a rising accent. Then I smiled, and said, "Yes, alcohol. Let's see—Ethyl or Methyl or Butyl?" Then I was aware of getting a drop of it on my nose and immediately had, in vocal-motor imagery, "Now, I'll cough." There was then a perceptible moment of waiting for that cough, and when it failed to appear, the Butyl possibility slipped out of consciousness altogether, and I said "Methyl or Ethyl, not sure which."

Again there are processes or consequents on all three levels—symbolic (images, verbalizations), affective (amusement, expectation), and postural (coughing?). And as specific details are added to the experience (drop on nose) the various alternative verdicts become more and more delimited, although they never in this case reached the point of unambiguity and complete certainty.

It is clear that in such an experiment the final "verdict" of the subject is only a late stage in the process, an indication of the general character and verbal significance of a more elaborate set of consequents. In the ordinary behavioristic experiment no attention is paid to these intermediate processes, but attention is given solely to the fact of presentation and the final act of indication which is objectively observable. Many of the more formal, mechanical, and circumstantial features of perception may be investigated by this behavioristic procedure alone.

VARYING POTENCY OF CUE DETAILS

A jury, confronted by evidence, may render a given verdict, as "not guilty," without any statement of the perhaps arduous process of deliberation which led to this verdict. So also in perception, a behavioristic "reaction" may terminate a long array of consequents which only the actor himself could report. Those interested only in the relation between presentation material and the final verdict, in time relations, in effect of repetition, interval, and so on, may treat the final act as if it were the whole process. And in some cases this final act may be the whole process, in which case the verdict comes

automatically, without subjectively reportable accompaniment. But usually, as in at least most of the following experiments, the final act is only a verbal or other indication of the "practical outcome" of a very complex perceptual activity which goes unreported.

Twenty-five printed sheets (advertisements), uniform in size and style, and all containing about equal areas of reading matter and illustration, were carefully examined individually by each of a group of observers. Each individual was then requested to select from a test series of ninety sheets those previously seen in the presentation series.

Of the twenty-five originals fifteen were present unchanged in the test series. Of the remaining ten, five contained the same illustration, but the reading matter had been changed, while five retained the original text but bore totally new cuts instead of the original ones.

In the test, the correct recognitions were as follows, these being the averages of all the subjects:

Unchanged sheets	77 per cent correct
Original text but changed illustration.........	56 per cent correct
Original cut but changed text.................	43 per cent correct
Substitution of cut remarked..................	26 per cent of cases
Substitution of text remarked.................	17 per cent of cases

It is clear that under the circumstances described the text is a more effective recognition cue than is the illustration, and the constellation of both cues is superior to the effect of either alone. But novelty in the illustration is more conspicuous than change in the reading matter. Some details of a context are thus shown to be prepotent, and cues are found to mutually reënforce each other, if compatible.

In another case geometrical forms cut from black paper were presented, and the test series contained these along with twice as many new forms. The accuracy of recognition varied remarkably with the character of the respective forms, the following being typical results from a group of twenty-five observers. The numerals in Figure 6 give the per cent correctness with which a given form was recognized.

The ease and fidelity of recognition under the circumstances is three or more times as great with some forms as with others. Some contexts endow their details with special potency. The potency in this case seems to depend on the ease with which the forms are named, and the arousal of a name seems to be an important feature of perception in this instance. The reader can readily call the first five forms by name but the

FIG. 6.—RECOGNITION VALUES OF FORMS.

last five, the inferior ones, are unnamable. The readiness and existence of a name for a form depend, of course, on previous contexts in which such shapes have occurred.

THE INFLUENCE OF POSITION

Position in a presentation series also influences the subsequent recognition of items in the test series. Thus when fifteen cards, presented serially, were later required to be identified in a test series containing the same number of new cards, as well as the former ones, the twenty observers gave the average results recorded in Table II, according to the original position of the cards in the presentation series.

The cards vary in recognizability, partly because of their intrinsic characteristics, partly because of their serial position. Averaging groups at beginning, end, and in the middle of the series, gives the best measure of position value alone. Primacy is thus seen to be a very effective determinant, re-

TABLE II

THE INFLUENCE OF POSITION

Position in the Presentation Series	Per Cent of Times Recognized	Averages of Groups of Five Items
1	84	
2	36	
3	44	44 (1 to 5 inclusive)
4	36	
5	20	
6	12	
7	16	
8	4	12 (6 to 10 inclusive)
9	8	
10	20	
11	4	
12	20	
13	28	25 (11 to 15 inclusive)
14	16	
15	56	

cency somewhat less effective. The poorest group is the middle one. The cards with highest scores are the very first and then the very last in the series. The very early cards of the series are better recognized in spite of the greater time interval separating them from the moment of the test. But the middle set, though more recent than the first set and more prime than the last set, are inferior to both of these. Primacy and recency thus appear to operate not merely as absolute temporal factors, but also with special reference to position in a context or organized group. Again, therefore, it is demonstrated that some features of a context are prepotent, and that the relative and absolute positions of a detail are redintegrative determinants.

These facts are neatly illustrated in the case of the misspelling of words.[2] Errors on the part of poor spellers are most frequent in the middle letters of words; errors are more

[2] See L. S. Hollingworth, "The Psychology of Special Disability in Spelling," *Contributions to Education*, Teachers College, No. 88 (1918), Chap. v.

frequent with the last few letters than with the first few letters. That is to say, regardless of the identity of the letters themselves, their potency varies with their *position* in the word. In determining perception and recognition the first or early letters are most potent; next in potency are the terminal or late letters; the letters near the middle are weakest of all. The following curves show for three poor spellers the distribution of their errors in the spelling of numerous six-letter words.

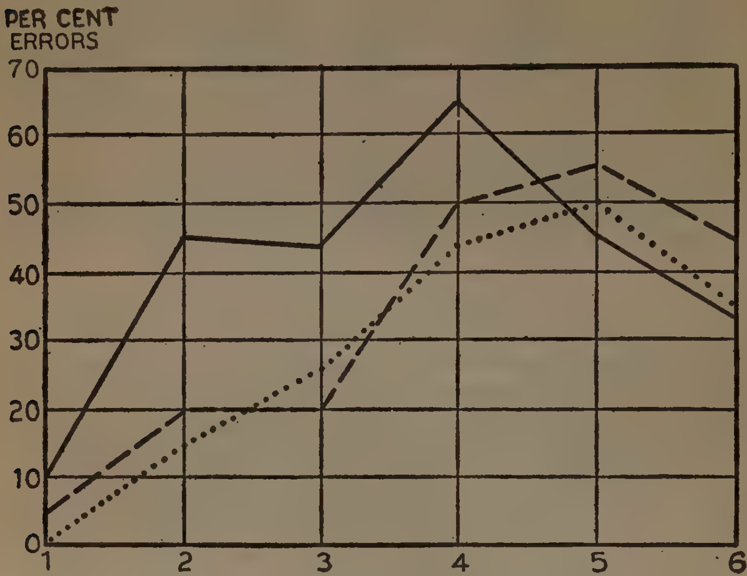


FIG. 7.—SHOWING THE FREQUENCY OF ERRORS IN VARIOUS PARTS OF WORDS CONTAINING SIX LETTERS.
From L. S. Hollingworth, "Psychology of Special Disability in Spelling," *Contributions to Education,* Teachers College (1918).

CONFIDENCE AND CORRECTNESS

In another case observers were called on to recognize syllables, forms, words, and pictures, at varying intervals after their presentation, and in each case to indicate, by the letters *A, B, C, D,* the degree of certainty of the perception. The let-

ter *A* was used for "absolute certainty," *D* for "pure guess," and the other letters for intermediate degrees of assurance. The average results in correctness for the different materials and degrees of confidence were as follows:

TABLE III

CONFIDENCE AND CORRECTNESS

Materials	Grades of Confidence and Per Cent Correctness			
	A	*B*	*C*	*D*
Nonsense syllables	76	56	58	52
Nouns and adjectives	85	67	55	48
Geometrical forms	86	64	61	50
Pictures of objects	93	83	57	No cases
Averages	85	68	58	50

For each type of material, correctness varies with assurance, but the relation of assurance to correctness is also different with the various materials. Moreover, both correctness and assurance vary directly with the complexity and meaningfulness of the materials. With the nonsense syllables both confidence and accuracy are relatively low. These increase through the more meaningful words and forms, and in the case of pictures with their greater complexity and their considerable representative significance, correctness is high and the lowest degree of confidence does not even occur.

Complexity involves a greater array of possibly effective instigative clues, and meaningfulness implies ready consequents, based on previous contexts. Recognition (perception) is thus favored by the number of available cues (completeness of data) and by their familiarity, just as the dog's response to linguistic commands varied with the number of signs concurrently employed and with the frequency of their use.

The confidence ratings express the subjective (introspective) aspect, and the percentages of correctness express the objective feature of the redintegrative effectiveness of the cues provided. When the former is zero (*D*, pure guess), the latter

is a mere chance measure (50 per cent when there are but two alternatives). The highest confidence may also be supposed to be lower for nonsense materials than for more significant objects, since the objective correctness of the *A* degrees of confidence is but 76 per cent with syllables, but is 93 per cent with pictures.

DESCRIPTION AND IDENTIFICATION

Further development of such findings occurs if the materials are presented repeatedly, until recognition is perfect for all items. And if the observer be required not only to recognize (identify) but also to describe (reproduce, recall) the materials presented, an interesting comparison is possible between the two processes and between the values of repetition for the two acts.

Twenty items were presented, visually, at intervals of two seconds, to many observers. Each observer, immediately after the presentation, was requested first to "recall" (reproduce or describe) as many as possible of the items and then to select from a test series of forty items the twenty just presented. The series was then again presented, and the reproduction and recognition test repeated. This process was continued until both adequate description and correct identification were completely achieved. The numbers of repetitions required in the two cases are thus secured. As before, four different materials are used, syllables, forms, words, and pictures. The average results are as follows:

TABLE IV

RECOGNITION AND RECALL

Materials	Repetitions Required for		Ratio of Reproduction to Recognition Difficulty
	Identification	Description	
Syllables	5.80	7.12	1.22
Words	2.64	4.76	1.80
Forms	1.80	3.96	2.20
Pictures	1.04	3.36	3.23

The first and most striking result is the greater facility of recognition. The effectiveness of a single detail is adequate for this process, or may be, whereas for reproduction the details must all be dealt with. Moreover, in recognition an actual cue detail is presented, or several, since the objective materials are actually re-presented. But in reproduction the only available cues are such symbols or "representations" as were devised by the observer for the disappearing objects. On the average, description requires about twice as many presentations as does identification, under these special circumstances and with these materials.

The second definite result is that the presentations become more nearly equivalent for the two processes (description and identification) as the materials become less meaningful. Thus for senseless verbal material (syllables) the two processes require almost the same number of presentations, while for significant verbal materials (words) reproduction is nearly twice as difficult as recognition. And in the comparison of non-representative graphs (forms) and representative graphs (pictures) much the same relation holds. Moreover, the difference between the representative materials (forms and pictures) which are symbolic through similarity, and the merely substitutive materials (verbal elements) which are symbolic through concurrence, is very pronounced.

THE INFLUENCE OF TIME INTERVAL

If the interval between presentation and test series is varied, the fidelity of recognition and the degree of confidence are found to decrease as the interval is lengthened. Instigative clues lose their potency as a function of lapse of time, if not meanwhile re-presented with their context. Whether the materials are to be described or identified, a curve such as the following results from tests applied at different times subsequent to presentation. The curve of effectiveness declines, first very rapidly, then less slowly, and finally practically levels out, in an asymptotic fashion, ever approaching but not entirely reaching a given limit. The curve given

shows the decline in recognition score, both correctness and certainty being taken into account.

Changes due solely to "lapse of time" are also reënforced by the occurrence of the details concerned in varied new contexts. As this occurs a "contamination" of instigative influence is produced, and particular instigative potency is weakened. Thus the items of a picture are encountered in varying settings

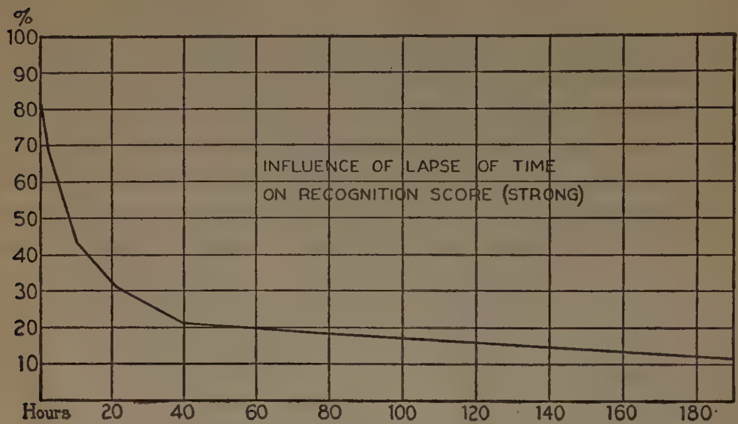


FIG. 8.—THE CURVE OF FORGETTING: THE VERTICAL LINE SHOWS THE AMOUNT REMEMBERED, THE BASE LINE THE INCREASING TIME INTERVALS.

From E. K. Strong, *Psychological Review,* September, 1913.

in other pictures, and recognition becomes only a vaguely instigated attitude or feel of *familiarity* rather than specific identification of the occasion or setting of a given presentation.

But that such contamination is not the sole factor responsible for "forgetting" is suggested by the curve of effectiveness, platted as a function of time. Miscellaneous encounters with contaminating contexts might be expected to result in a gradually declining line, of uniform or irregular slope. Instead, the curves actually secured decline in the fashion illustrated. The rapid early decline is presumably due chiefly to special temporally dependent influences. The later section of the

curve accords more nearly with what we should expect from gradual contamination.

We may point out again that such results are not peculiar to the process of recognition: they characterize all mental sequences. In just this way also the neurotic soldier loses his fear of sounds, the dog's salivary secretions fail to follow the bell, the child loses the meaning of the linguistic symbol, the spoken "yellow" fails to arouse its characteristic imaginal color, and synæsthesias disappear in adult life.

SUMMARY

These typical experiments are here presented not because their intrinsic importance is great, but in order to illustrate the existence, in perception, of special tendencies along with the general redintegrative principles. Even these results may be expected to vary with change in the materials, the personnel, the time relations, the series length, and with innumerable other variables. The situation is no different from that in other sciences. Thus botany and physiology may formulate general laws of growth, but must also consider the detailed variable features of each special set of conditions. Medicine may outline the general course of a disease, but individual patients will each require particular study. Physics may state the general gravitational laws, but every moving object has also its special idiosyncrasies, depending on the particular setting and circumstances.

We may close this very general introduction to the psychology of perception by stressing once more the general redintegrative character of the process, which is the key to its detailed investigation. Perception of natural objects is the interpretation of natural signs. Natural signs are parts of antecedent complexities. In perception these complexities are not revived nor evoked in the mind nor reconstructed through supplementation. Instead, a partial detail or cue more or less effectively instigates a response in class with former consequents (symbolic, affective, or postural). Because of the general uniformity of natural occurrences, such adjustment has adaptive value

and appropriateness to the larger contexts of which such observed details are signs or parts.

Correlated with the objective fact called correctness is the subjective continuum of felt confidence or conviction. These both vary according to the general redintegrative principles. In addition, the perception (recognition) of each type of natural object or situation has its own special array of determinants, depending on such variables as materials, personnel, setting, time relations, frequency, and the like.

Natural objects, though perceived on the basis of momentary events, are themselves more likely to be temporally, spatially, and otherwise extended series. The pain is more than the pang of a given moment. The melody is more than the tone now sounding. The pencil is more than the particular visual or tactile appearance. The war is more than a specified attack or retreat. But although natural objects are often comprehensive incorporations or integrations of many features or items and relations, they are not made of any *stuff* other than these events themselves, by whomsoever observed, reported, or inferred. And the signs or thoughts of natural objects are not occult essences nor supernatural "conscious states"; they are intrinsic parts or fragments or features of these objects themselves.

CHAPTER IX

THOUGHTS AND THINGS: THE NATURE OF IDEAS

THE MATERIALS OF THINKING

As we have seen, some natural events become the signs of others. As parts or features, they function for larger contexts. In so far as this is the case they are *symbols* of the more elaborate complexities which they thus stand for, point to, or represent. Considered in this rôle of part-for-whole activity, the part or detail may be described as an *idea* or *thought* of the larger object or situation. In so far as the bell sound leads to the salivary secretion appropriate to a more inclusive context, the tone *is* an *idea of* that total context. The word "Fire!" is a thought or idea, in so far as the consequents which it instigates are appropriate to the circumstances of an actual conflagration. The felt movements involved in kneeling are thoughts, in so far as the emotions and the imagery to which they lead are dictated by former and more complex situations of piety and devotion.

In so far as the photograph of a loved one instigates words, acts, or feelings originally established in connection with the complete personal presence of that being, the photograph is not merely an object in its own right. It is also a symbol, a representative, a surrogate, and hence an idea or thought of the absent person. It is this because it contains elements (relations of contour, shape, feature) which are in class with similar elements of that complexity called "a friend," and it arouses consequents appropriate thereto. I may think of or represent absent or past objects by a great variety of means, providing only that these materials in whole or in part have been partial or often concurrent details of such past settings.

Thus a general in his headquarters may be thinking of or

representing the locations, dispositions, equipment, and movements of his various regiments, and of the maneuvers of the enemy. What in such circumstances comprises his thoughts? It is easy to see that his ideas, signs, or symbols may consist of any one or more of a great variety of materials. And whatever the materials, they consist of actual events now occurring or present in nature, not of occult essences of any sort. We may profitably consider some of the diverse ways in which such an officer may "think of" his troops and plan or "think out" his campaign.

THE THOUGHTS OF AN ARMY OFFICER

The general may employ a wall map into which have been stuck colored pins of assorted sizes and in different positions. The areas, lines, and divisions of the map "graphically represent" the battle region, with its plains, rivers, hills, roads, woods, and villages. The colors of the pins "stand for" the friendly and enemy forces, the blues being his own troops, the reds being the enemy. The locations of the pins and their shifts in position symbolize movements of the regiments. The sizes of the pins signify the number of men in the various organizations. The general may even use devices to indicate the experience, the valor, the equipment, the amount of recent activity of the various regiments, the skill of their commanders, and the like. The spatial relations, as of station, movement, direction, portray in miniature the larger spatial relations of the combatant groups.

Or, lacking this elaborate and highly artificial array of symbols or surrogates, the general may resort to marks in the sand, made with a convenient stick, or to penciled diagrams on a sheet of paper. Or he might write out or speak aloud a verbal description of the circumstances, personnel, and plans, or in "silent speech" represent in none the less verbal form, the whole affair. This "communing with one's self" was recognized by Aristotle as one of the most common modes of "thinking." In such a case there is no "resemblance" between the symbols employed and the items represented. Even the

actual spatial relations are now represented by words occurring in the temporal flow of speech. Here these very words, as delivered, felt, and heard, *are* the thoughts, the ideas, the symbols.

In such verbal deliberations the general might find it useful to employ also overt or tentative gesture, especially in indicating vividly or impressively the spatial relations and movements of the troops. And a given gesture might mean, in one context, an act of the enemy; in another context the same gesture might mean instead the performance of his own men.

Speech being relatively slow, the general might, especially if thinking only "to himself," use gesture profusely. Other motor activities, such as eye movements, bodily postures, stresses and strains in the musculature, might be utilized, for thus one can hurriedly handle the general aspects of a process which verbalization can only convey by a long articulation of discrete words.

Such a general, if time were not pressing, might also, as he lay silently and quietly on his cot, be representing the various features of a campaign through such array of "mental images" as were customary to him. Closing his eyes he might review his troops, visualizing their appearance, or might, in a visual image of his wall map, locate visual images of the pins he had been using. Auditory imagery of rapid and clattering sounds would stand for charge and attack. He would hear his men sigh with relief, shout with excitement or triumph, and would hear the snappy barking of the commands of the officers.

Meantime changes of stress and strain, contraction and relaxation throughout his body, eye movements, feelings of pleasure and discouragement, the current sounds of the neighborhood, the rhythmic processes of breathing, entoptic phenomena arising in his visual field, perseverating movements, as of the setting-up exercises vigorously gone through before retiring, might any or all of them from time to time be utilized in or adapted to the rôle of representing places, people, things, relations, activities to be involved in the prospective campaign. Even the "prospectiveness" of this campaign would be in some such terms represented.

All such materials, in so far as they functioned for more elaborate complexities, would be ideas, symbols, or thoughts. They would achieve this symbolic status by virtue of their presentation of features, as of quality, position, or other relations, which were also features of more elaborate contexts such as those which they now mean. Thus a *slow backward* movement of the hand conveniently represents a *steady retreat.* Whether it represents a retreat of the enemy or a retreat of the general's own troops, would depend on its own present context, as what the other hand might be doing, or what words might at the moment be occurring, or what eye movements. *Right* and *left* as conventional opposites of a spatial sort, might here stand for *friendly* and *enemy* forces, just as the spatial relations of musical notes on the staff stand for temporal and pitch relations of musical tones. *Upward* eye movements, for the general, might neatly symbolize northward progress. Such signs would have been derived in a secondary fashion, not from the immediate events which they represent, but from other *signs* for which they are in turn substituted (as the conventional directions on a map). Thus the origin of the meaning of symbols may be several steps removed from the actual occurrences for which they stand. Sounds stand for objects other than themselves; printed letters stand for these sounds; the telegraph code, the point patterns used by the blind, the manual signs of the dumb, come in turn to stand for these letters. Thus there may occur a long process of secondary and tertiary derivations, in which the origins of the meaning of signs may come to be very much obscured.

Imagery, however loosely approximate in its fidelity, is adequately symbolic so long as fine and precise distinctions are not required. From his dreams and drowsy reverie our general would start up suddenly as the play of imagery and attitude might be modified by internal and external stimuli. These, vicariously "carrying forward the thought," might result, because of their accidental origin and looseness of representation, in climax and denouement of glorious or gloomy character. Even in his dreams the general is "thinking of the battle."

In fact the important thing about the whole process is that at whatever point the general might be interrupted by an inquisitive psychologist and requested to "describe his thoughts," the general would persistently say "I was thinking about the battle." He has not even noted just what *materials* he was using in that process. And when now required to describe these, perhaps the most that he can do is to offer *other symbols,* such as the words he speaks, which are *synonyms* of the materials he has been actually employing, and might have been used instead of these materials. Except in the case of those very skilled in "introspection," the description of their thoughts is almost never an account of the materials employed but a set of verbal synonyms for these materials, that is, some other indication of the objects or absent contexts for which these materials were redintegratively acting.

THE REALM OF IDEAS

The present point is, then, that ideas or thoughts are not occurrences in any realm other than that in which occur also the actualities for which they stand and whose rôle they play. It is a gross but prevalent and long-standing error to suppose that objects occur in a nailed-up, physical world of reality, while thoughts of them occur in a severed and nebulous world of "consciousness." Thoughts (symbols) and things (situations), we have tried to show instead, are alike natural events. The thoughts are either intrinsic or concurrent features of complexities for which they act, toward which they are figuratively said to point, or which they mean.

The membership may be as intimate as that in which a photograph or statue represents a face, and a wall map represents in miniature the continent on which a local battle is waged. Or the membership may be as extrinsic and artificial as in the case where a word or gesture, with neither head, tail, nor legs, nevertheless effectively acts as surrogate or symbol for a quadruped. When the boy in the fable cried "Wolf! Wolf!" he projected a thought (this noise) into the ears of his auditors. That the sound was really a thought, that is, a sig-

nificant symbol, is evidenced by the prompt agitation into which it is said to have thrown the listening owners of the sheep.

Men have come to attribute ideas or thoughts to an "inner world" and objects to an "outer world." We may do well to inquire into the basis and validity of this distinction. At least two different influences seem to be responsible for the very misleading separation of thoughts from things. The first is the fact that in the life of sophisticated adults it is not necessary to employ maps, counters, and strings of beads in order to think. Events "in the organism," such as the kinæsthetic features of shifts of gesture and posture, eye movements, activity of the facial musculature, the astonishingly nimble processes of vocal and silent speech, and various "organic sensations" and feelings, come to constitute an intricate alphabet and vocabulary of symbolism.

Many of these materials are fairly complex configurations which may be partially known to the actor through kinæsthesis or through correlated visual and auditory events. To the thinker's associates his motor activities are known only as visual, auditory, or tactile changes. And the larger number of such activities, as employed in thought, are so "delicate" that although the actor knows them as kinæsthetic events, the onlooker does not report any correlated sights or sounds. In this sense, then, thoughts do often occur "in an organism," and intraorganic events may play a symbolic rôle. In Rodin's famous statue of "The Thinker," the immobile pose suggests that it was in part just such delicate intraorganic events that this thinker was at the moment employing. But many thinkers are typically both less immobile and more vociferous than Rodin's model. Of course, the mere barrier of the skin does not justify the allocation of such events to a peculiar or severed realm. Inside or outside the skin is only a spatial distinction, similar to inside or outside a room.

In another sense, also, thoughts come to be attributed to an "inner world," in as much as often the materials employed are reportable and usable by but one person. This is the case, for example, with the kinæsthetic events which lack conven-

ient visual correlates, or those whose correlates are so obscure and intricate as to defy visual analysis and graphic portrayal. Such cues are accessible only to the introspection of the actor; that is, they have but one reporter. So also with the general's imagery. Only he is in position to disclose either the occurrence, the nature, or the course of these imaginal events, just as only he can observe his aches and pains.

Of course, there are also cues or codes which more than one, but yet only a restricted number, can employ. Thus the general and his staff could use cipher codes which would be lacking in meaning (not symbolic) for the noncommissioned officers and privates of the army. Many mothers use "baby talk" with which only they and their offspring can "think." For many trained animals there are systems of signals which only a few keepers can report. The deaf and dumb are almost a closed but nevertheless large fraternity in the understanding of certain gestural materials of thought.

But traditionally a sharp line has been drawn between the number 1 and all larger numbers. So that events, perhaps easily reportable by *one*, but not, even through effort and study, accessible to *others*, have been given a peculiar place in the universe. They are said to occur in an inner world of mind, which is thereupon conceived to be separated, as by a vast gulf, from the outer world of nature.

It seems astonishing and almost incredible to the dispassionate onlooker, that men should have been so overimpressed by this particular numerical difference—that between one and several. But the impression has been made, and it has thoroughly obfuscated the history of philosophy and psychology. The most useful therapy for the student who has also become infected with this "number form" is perhaps a clear realization of its genesis. Many obsessions lose their coerciveness once their origin is understood.

THOUGHT AND ACTION

Thoughts are therefore things. But they are things whose instigative effectiveness is determined not merely by their

intrinsic make-up, but especially by their past history, or by the biographies of reporters to whom they occur. With this in mind we may consider a distinction that is often made between thinking and acting, between reflection and conduct. It is a very convenient distinction as long as one is not overawed by the ancient but vicious dogma of formal logic that "a thing is either *B* or not *B*." This has been called the "law of excluded middle" by logicians.

This famous fallacy has often been asserted to be one of the fundamental axioms of logic. Perhaps that is one reason why logic has so little relation to the actual psychology of thought. Certainly, if any proposition was ever "wholly true or wholly false," this one is the latter. To say that a man is either sick or not-sick is grossly to misapprehend the nature of illness. To insist that a man is either sane or in-sane is only a sign of woeful ignorance of the continuum represented by the degrees of mental balance. Similarly, to insist that a performance is either thinking or acting reveals only a slovenly observation of nature. Most human performances, for example, are some combination of thought and conduct, or, more accurately, present an ambiguous pattern that is not unequivocally one or the other.

Abstractly we can describe action as the direct manipulation of objects, in terms only of their own qualities, with no regard to their history. As so manipulated, objects are meaningless; they lack symbolic character. Thought would then be defined as the play of objects solely in terms of their symbolic value, their surrogation for absent contexts. Such extremes may be suggested, though far from fully realized, in a series of examples from the behavior of an automobile mechanic. Suppose that the motor he is driving down the road suddenly stops. We may then describe various alternative performances on the part of the mechanic. It may be noted that in this chapter our account of thinking is on a purely descriptive level. We are describing the materials and modes of thinking without reference to the motivation, the hygiene, or the pedagogy of reflection.

THE ACTIVITIES OF A MECHANIC

1. The mechanic may sit contentedly in his seat, smoking his pipe, daydreaming of his future, reviewing his boyhood, and wishing for some one to come to haul him home or adjust his motor. He is, to be sure, doing little but thinking, but after all there is no apparent symbolism in his breathing, his smoking, and certainly his treatment of the car is anything but thoughtful; he treats it only directly, as a solid object on which to sit.

2. Or he may begin diligently to rehearse verbally or by means of imagery and with the aid of gesture, eye movement, and posture, the organization and parts of an internal combustion engine. There is a rapid and intricate play of such activities. If suddenly interrupted and required to give a verbal summary of what is going on at a given moment, he will say he was "wondering about the carburetor," trying "to remember the firing order," "considering whether his gasoline tank should now be empty," and so on. In such a case his treatment of the machine as a mere object would, however, be conspicuous. He would glance now at this point, now at that; gesticulate now to one side, now to the other, now front, now back. He is chiefly perhaps thinking, but his thinking sticks fairly close to the inert object which constitutes his obstacle.

3. He may, instead, pull from his pocket an instruction book. This is full of diagrams, charts, figures, pictures, and verbal description and suggestions. These he diligently traces with his pencil, carefully scrutinizes, and turns from one to the other, and back, perhaps muttering as he does so. He is still, to be sure, thinking about his motor, but in doing so he is using these objective materials. His thoughts consist of these generally observable graphic diagrams and charts, symbolic of the parts and organization of the machine. He takes these from his pocket, holds them in his hand, lays them on the seat, just as he might handle his pipe or screw driver. What we observe him doing then is chiefly "handling" these objects. But after all, as objects, they are pictures *of*, dia-

grams *of*, the machinery. They are, that is to say, *symbols*, although they may appear to be more overtly manipulated than were the presumed thought materials of the two foregoing instances.

4. Or the mechanic may not "waste any time pondering" at all. He may promptly spring to the ground, raise the engine hood, and begin a long series of tugs, jerks, openings, liftings, and similar manipulations of the parts of the motor. Thus he may suddenly bang the vacuum tank with his fist, then climb back to his seat, push down on the self-starter, throw into gear, and drive triumphantly along the road again. Nothing but activity, shall we say? No thinking? No reflection? But after all the mechanic did not pound the vacuum tank merely as a meaningless object, nor because "he just had to hit something."

No, the tank, in its position, with its connections, through its contents and its rôle in the machine, is part of a complex siphon system, an elaborate feeding context. And the visual appearance, from the side of the car, is but a partial feature of "the vacuum tank" as otherwise known to the mechanic, and "understood" by him. The tank is after all a meaningful thing and the car as a whole is something more than a "mere" object; it is a symbol of transportation, a sign of progress, "the last word" of modern industry. Even in such random activities of the mechanic as falling asleep, rolling off his seat, colliding with a telephone pole, deep meanings might be discerned by the well informed.

Perhaps the nearest approach to mere activity on the part of the mechanic could be found in those changes which we call his reflexes. These unlearned movements, directly and "physically" caused by such stimuli as light, sound, contact, seem to have no "reference" to his own past, nor do the stimuli function as symbols of past episodes in the life of the mechanic. His pupillary changes, his knee jerk, his cough and sneeze, the blink of his eyelid, seem to follow stimuli which have no meaning. At least they seem to be effective at so early an age that we cannot attribute their stimulus value to their rôle as symbols for any larger context in the life of the

actor. Such reflex behavior seems as close as we can get to conduct that is wholly thoughtless. And even here there arise at once puzzling questions which we may later encounter again. For the biologist may assure us that "in the life of the species" such stimuli have a very vital "significance."

THE PSYCHOLOGY OF MEANING

In many respects the most crucial topic of any systematic account of psychological facts is the problem of meaning. One of the most entertaining of abstruse diversions is the comparative study of the historical definitions and descriptions of the nature of meaning. Without going into details, we may instructively note what some of these have been. An entirely just and comparative survey would itself occupy a volume, but we require only a sufficiently full statement to serve as background for our own description.

1. Meaning has been said to be a peculiar, transcendental feature of some facts, by virtue of which they point beyond themselves, reveal more than they are, imply more than they constitute. This transcendental pointing, as thus described, is a wholly unique and inexplicable mystery, for the designation of which such terms as "immanent intention," "transcendent reference," "logical implication," and "indwelling absolute" have been employed.

2. Meanings have been asserted to be unique unanalyzable universals, categories, mental structures, pure thoughts, dispositions of the soul—occurrences of an ineffable, nebulous nature, either in a "purely logical realm" or detectable and identifiable "in consciousness," yet not reducible nor describable, and perhaps not correlated with the neural activities with which other "mental processes" seem to have some relation.

3. Meanings have been described as the fringe, margin, or context of sensation, image, and affection, which introspectively surrounds, follows, or accompanies an impression or sensation that occupies the focus or clear point of consciousness. Thus a heard word would be the nucleus, occurring in a matrix or setting of imagery and sensation, which intro-

spectively discernible halo would be the meaning of the heard word.

4. Meanings have been said to be constituted by the motor adjustment to which an observed event (impression) leads. Thus the meaning of a word would be the thing I do upon hearing it; the meaning of a bed is the recumbent posture I assume when I encounter it; the meaning of an itch is the set of scratching movements which it provokes; the meaning of a statue, a flag, a crucifix is whatever it makes me do in its presence. Thus one psychologist writes that "the instinctive responses which the objects evoke are the meanings of the objects for the animals"; and another writes, "The meaning of an object is our attitude toward that object, our reaction to it."

5. Again we are told that meaning is the suggestion value of objects, or perhaps is whatever the object does suggest, be this image, movement, feeling, or what. If a word suggests an act, another word, a feeling or image, the meaning is either this suggest*ing* or these sugges*tions*. The meaning of the seen stick of candy is perhaps its suggestion of the image of a sweet taste, or is this image itself.

We need not pause to examine the manifest inadequacies of these accounts. In the main, each type of theory has happily hit upon one feature of the truth and has dramatically overstated this, grotesquely magnifying it into a pretended picture of the whole situation. We may best state first the nature of this whole, then, calling attention to its various features, note how they reflect, if taken in isolation, these various outstanding theories.

If meaning is a mental phenomenon, it will be found in a redintegrative situation. As a matter of fact a meaningful situation involves the whole mental paradigm. Meaningfulness is involved when an item instigates a consequent appropriate to a former complexity of which it was a partial feature. Meaning thus involves the following four factors:

(*a*) A present cue or item, which we may call the *significant*, or more simply, the *sign*.

(*b*) The instigative potency or redintegrative activity or stimulus value (*signifying*) of this sign.

(*c*) The response or consequent, the *significance*, which the present cue thus instigates.

(*d*) The former context, the *signified*, for which the present sign is a surrogate, and of which it was a partial or concurrent detail.

The "transcendental" theory noted the very important fact that the present item functions for something larger than itself. The "fringe" theory noted that the term "context" is always applicable to a meaningful situation. The "motor" theory observed that the consequent often is actually an overt movement on the part of an organism. The "suggestion" theory correctly observed that meaning always does involve sequences, in which one event instigates another. The "soul structure" theory noted, what is actually a fact, that that which gives the sign its significance is not usually any describable present pattern in nature, and yet it is effectively registered. But this theory located the effective context "in the soul" rather than in the past.

One classical theory has thus exalted the sign, another the signifying, another the signified, and another the significance, and each has supposed that it was describing the fullness of meaning. But meaning, as we have indicated, is neither the one nor the other of these features in isolation. Meaning is the whole redintegrative situation. And meaning, as thus described, is the essence of mental affairs. It is the one embracing fact or pattern which includes all psychological activity. The problem, in the study of any mental or meaningful sequence, is that of identifying the sign, the signified, the significance, and inquiring into the condition and manner in which the signifying takes place. With such an account the ineffable character evaporates, and the investigation of meaning becomes a straightforward descriptive enterprise of natural science. Just such an account we have, in fact, been constantly giving in the preceding chapters, in terms of the redintegrative paradigm and its general and special laws.

LEVELS OF MEANING

We might classify meaningful situations on the basis of the character of the signs involved in them. Thus we might consider verbal signs (whether seen or heard), musical signs, pictorial signs, mathematical signs, and the like. Or we might classify meanings in terms of the original and complex antecedents (the signified) for which such signs are surrogates. Thus we might have military, domestic, political, industrial, religious, and numerous other situations in which the instigative potency of signs might originate. No such classifications have been made in any systematic fashion, and the task would be tedious and of doubtful instructiveness.

Somewhat more feasible is the classification of meanings in terms of the nature of the instigated consequent. Thus if the stimulus is a melody which I hear, I find consequents which are fairly easily assignable to three general groups of levels, which we have already indicated as the postural, the affective, and the symbolic.

Hearing the melody, I find myself beating time, swaying rhythmically, marching briskly back and forth, or waltzing about the room. The overt motor activities are for me complex visual, tactile, kinæsthetic, and auditory patterns with their characteristic relations of space, time, and order. My neighbors also report, consistently with me, the visual and auditory features, but have no access to the tactile and kinæsthetic changes as I find them. In turn I observe the visual and auditory changes in my neighbors' conduct, which I call their dancing and swaying. And they report also tactile and kinæsthetic events, using much the same words as those I employed for my similar reports. These overt bodily movements are postural consequents.

Again, the heard music may provoke events which I call by such names as "being stirred," "feeling exhilarated," "being pleased," or "calmed," "soothed," "interested," and so on. It may not be possible for me to analyze such events into simpler elements. Perhaps I can only apply vague names to them, as I do also to unfamiliar plants, animals, and machines

visually encountered, much as children call all kinds of things "bugs."

One watching me as a visual object, or observing instruments attached to my body at various points might report also an array of "bodily changes," such as quickened pulse, modified breathing, heightened or lowered muscle tonus, glandular activities, changes in electrical potential, diffuse muscular contractions or motor sets, modified metabolism, and similar events. For the observer these are names given chiefly to complex patterns and serial variations in certain of his visual or tactile objects—his instruments or the tissues and organs of my body. My reported feelings, my affects and emotions, may appear to be more or less closely correlated with these events. The correlation may be so close that both series may be incorporated in that complex event which we together call the psychophysical life of my organism. But as known to me, these events are affective occurrences or consequents. Even the observing neighbor may find it convenient to distinguish these obscure "emotional changes" from the more overt postural changes such as dancing and beating time.

Finally, the heard melody may instigate an array of events which in one or another way may serve as synonyms or names for the past situations that give the melody its potency. These events are thus *other symbols*, which might under appropriate circumstances be substituted for the melody as a sign of the past context. Thus they might be mental images of the original occasions in which such music was heard. They might be simple or complicated verbalizations, words, sentences, or long narrations. Or both images and words, and with them indicative gestures, such as slight nods, directions of gaze, or vague but specifically symbolic bodily attitudes, might comprise the consequent. Such responses would be on the symbolic level. They are other symbols for the past context, and their occurrence constitutes what we familiarly call my consciousness of the melody.

Music may thus be meaningful in three distinguishable, even if concretely inseparable, ways. It may be understood, appreciated, or acted. Even an object so relatively poor in sym-

bolic character as a brick may be named, admired, or kicked. The symptoms of the neurotic soldier were seen to lie on these three general levels, as did also the reactions to words, and the processes involved in perception or recognition. These are approximately the thinking, feeling, and doing of the classical psychology. Although the distinctions are far from sharp, and in any concrete case all three aspects of meaning responses are almost surely inseparably fused and combined, the distinctions will be found to serve a useful purpose in psychological description.

Adjustments on these various levels are also interrelated in various interesting manners. Thus if consequents on the postural level are blocked or impeded, responses often become increasingly conspicuous on higher levels. At the cry of "Fire!" I first run to the door, starting to leave the building (postural adjustment). But if the door is locked on the outside or the key has disappeared, and my postural adjustments are thus thwarted, panic and excitement ensue. These may give such strength to my attack upon the door that the panels or the hinges yield to my blows. Failing this outlet through affective and emotional outburst, I may then pause "for reflection"; that is, I analyze and symbolize the situation, visualize various alternatives, verbally present solutions, or in gesture rehearse possibilities which may ultimately constitute escape from the situation signified by the instigating word.

On the other hand, formulæ, instructions, receipts, at first followed with painful verbal and imaginal exactitude come in time to be handled in terms of vague affects and attitudes in which proportions and order are dictated only by their "feel." Finally the acts become mechanized and automatic, and constitute habitual postural activities. Thus, using a typewriter begins as a science, becomes facilitated into an art, and finally mechanized into a skill. Such processes will occupy us more specifically when we undertake the description of learning.

Finally, it may be noted that affective responses are less likely to arise if effective adjustments occur on either the postural or the symbolic level. The "dreadful sound" is less likely to produce fear if I can readily identify or name it, or

if I have effective and defensive postural adjustments at command. Substituting a postural or a cognitive adjustment for an affective one is a favorite means of psychotherapy when the complaint is proneness to incapacitating emotions.

The meaningful character of a sign often lapses or disappears if the instigative activity of that sign fails to occur. It is for this reason that prolonged dwelling upon a word makes of it a relatively meaningless noise. Sounds have meaning only in so far as they tend to redintegrate consequents. Prolonged observation or mere repeated vocalization may involve inhibition of or interference with just that course of redintegrative sequence which makes of the word a meaningful sign. When such sequences fail, meaning is absent, and the word is then "strange," and tends to become more and more a "mere object."

NATIVE AND ACQUIRED CONSEQUENTS

The most familiar sequences of nature are those of the mechanical or physical type, in which no symbolism is involved. The energy manifested in the consequent may vary directly and proportionately with that of the antecedent. When the mallet hits the croquet ball, the movement of the ball varies in speed and distance with the point and force of impact. The ball's behavior is uninfluenced by the history of the mallet or the personality of the player. There are also other sequences in which stored or latent energy may be released out of all proportion to the initial magnitude of the stimulus. Thus the impact of the trigger upon a percussion cap produces an explosion of great violence, depending chiefly on the potential energy of the powder, and the conditions in which this is confined. A slight kick may release a boulder and eventuate in an appalling landslide. Very often also energy waste, or other influence, produces diminishing returns in a particular consequent for which the activity may have been initiated. Thus the loudness of a sound, the brightness of a light, the speed of a ship, increase less rapidly than do the increments of energy involved in the production of these increases. But in none of these cases are partial stimuli substituted for larger

antecedents, whether in the determination of the quality, the direction, the pattern, or the magnitude of the consequent. Hence they do not involve meaning, and are physical, not mental sequences.

In the life of organisms there are many activities of this order, as for instance the growth in stature, the wearing away of teeth. Of special interest are the native reactions or reflexes of such organisms. Lower organisms, in some of their *tropisms,* repeatedly and inevitably react to thermal, photic, mechanical, and other conditions in immediate and stereotyped ways. Such tropisms, however adaptive in the main to the most probable conditions of the natural habitat of the organisms, may result in disaster in exceptional circumstances and in the artificial conditions of the laboratory. It is, however, commonly supposed that such behavior has on the whole some biological utility in the life of the individual or the species and this is often demonstrable.

In more complicated creatures, such as man, there are to be observed reactions of a like mechanical character, although most of these seem capable of participating in sequences involving at least a low order of symbolism. The stock example is the pupillary reflex, in which the size of the pupil decreases in brighter and increases in fainter conditions of illumination. In the same general class fall also such processes as glandular secretions, the activities of the heart and the vascular system, digestion, such acts as sneezing, blinking, coughing, excretion, turning the eye toward a bright light, starting at sudden stimuli, sleeping and awakening.

So far as we can observe, such sequences are of the native or unlearned type. The organism, we may suppose, is so constructed that even before the time of birth, in many of these cases, it responds in these characteristic ways to specific stimuli. And it has long been supposed that human beings "in a state of nature" would also exhibit more elaborate and relatively fixed patterns of adjustment, the instinctive acts, which we can, however, best illustrate by citing the mating, nest building, and locomotion of lower animals.

For the present we are concerned only with the question

whether such native sequences are meaningful. We must conclude that in the psychological sense of the word they are not. That they may be important, adaptive, and utilitarian in the life of the organism need not be doubted, although there are often instances in which it is at least difficult to show this to be the case. They seem to be on the whole adjustments which, as the organism concerned is now constituted, further the vital welfare of the individual or facilitate the perpetuation of the species.

A teleological type of biology may go so far as to intimate that the stimuli concerned are, as a matter of fact, only signs or symbols of more elaborate situations which, in the history of the species, have required definite reactions under penalty of injury. But the procedure by which such signs become effective in contemporary organisms is commonly described not as a formative or ontogenetic but as a selective and phylogenetic affair. It is the mechanism of selection and heredity, rather than that of experience and learning, by which all but the more mystical biologists seek to account for native reactions.

However intriguing the concepts of "racial experience" and "vital significance" may be, it seems best in the present state of our ignorance to limit the term "meaning" to situations based on learning, that is, on prior adjustments rather than on heredity. Native reactions are not to the meanings (the signified) of events, but to the events themselves. Meaning involves, as we have seen, prior sequences in the life of the system concerned. Meaning, therefore, involves the formative process of learning, and it is to the detailed consideration of this process that we must soon turn.

Redintegrative sequences of the two more conspicuous modes, those involving partiality and concurrence on the part of the stimuli, as distinguished from those involving merely reduction of the stimulus intensity, occur, so far as we know, only in connection with organisms. Except for a few dubious instances cited in the case of plants, they seem, morever, to be limited to the activities of animals or to situations in which animals are always concerned, if only as reporters. Psychol-

ogy is, therefore, primarily concerned with some of the activities or reports of living organisms.

THE POWER OF IDEAS

We may briefly summarize the outstanding theme of this chapter by commenting on the undoubtedly remarkable fact that "ideas have power." Ideas are made of the stuff of nature, although they may range in complexity from patterns of kinæsthetic and imaginal quality, through such more elaborate occurrences as gestures, words, graphs, signposts, to the intricate complexities of elaborate maps and books. Ideas, of some sorts, may be stacked on shelves or carried in the pocket. Those of other sorts are cherished in the organism or found in the world of sense quality and image.

The "power of ideas" has often been treated as an occult topic. But the power of ideas is the power of things. That one thing should lead to another in nature—that fires should warm, impact result in movement, electric stimuli produce muscular contraction—of course, no one can ultimately justify. Such things do happen and all that explanation does is to describe them, either more minutely, or else abstractly and with high generality. Even the characters of space and time and the properties of number, we can only accept, describe, and use.

We cannot "account for" the sequences of nature, nor for nature as a whole. Explanation is a process arising *within* nature, as are also such facts as location, causation, cost, beauty, and justice. All these are relations of one natural event to others. To demand explanation of nature as a whole, or of its most general features, would be as absurd and fruitless as to ask to know the cost, the whereabouts, or the temperature of the universe.

Antecedents do have their consequents. And in certain cases (mental sequences) partial features of former antecedents play the rôle of these complexities. Such partial features are ideas; they are stimuli in just the same sense that larger patterns are stimuli. The effectiveness of the parts can

no more be explained than can the facts of the original sequences. But the features can be identified, the consequents described and analyzed or classified, and the conditions and correlates of the process can be investigated. This is the task of psychology.

The "reason" that ideas have power, when they do, is that "their originals" were powerful. It is for such reasons that "paper and ink can cut the throats of men," orations and flags inflame a populace, mental images produce movements, the eye movement of a general determine the fate of regiments, and the name of a hero shape the development of character and temperament.

It is no more mysterious that images can produce movements (as in certain kinds of voluntary action) than it is that dogs and horses obey verbal commands, that salivary secretion follows the sounding of a bell, or that harassed soldiers tremble at the sound of guns. Paraphrasing the words of Burke, already quoted in connection with the study of language, we may say that "ideas are ordinary events, but events such as have previously occurred on particular occasions, and which produce, when they afterward occur, effects similar to those of their occasions." The mystery of ideas is the mystery of redintegrative sequence.

It is for such reasons also that the power of ideas depends in part upon their number, their mutual reënforcement. Thus such ideas as the printed words of a play easily instigate such postural adjustments as the fixation and eye movements of reading. They may also lead effectively to images, words, and other symbols which constitute "purely intellectual" understanding. But they are often relatively weak in the power to arouse feelings and emotions. More "power" may be secured if "more ideas" are supplied.

Thus if the individual, or another person, reads the text aloud, the voice tones afford further clues and the "meaning" is more vivid. If in addition, as in the staged drama, the actor supplies further cues through gesture and facial expression, these further "ideas" make the play still more "impressive." In the opera there are added still further details, of symbolic

value. The music of the orchestra and the expressive quality of human singing combine with numerous other features of symbolism. These are the suggestiveness of costume, symbolic settings and locations, effective objects of human symbolism, such as thrones, uniforms, ceremonies, dances, all of which add to the "number of ideas."

The more the ideas are piled up (the greater the number of effective details), the more moving the performance is recognized to be. This is not merely because of the constellation of many ideas of similar meaning. It is also because wherever the observer looks he finds some such symbol. And if his glance strays from the stage, the voices and the musical tones still haunt him. Each idea derives its power from its history. A given group of ideas also derive increased power from their joint action or constellation, provided that they work in compatible directions.

Finally, events are ideas only when they so function. Severed and abstracted from the actual sequences and activities in which they play a rôle, they are no longer ideas. A word, an image, a kinæsthetic pattern, is an idea only when and in so far as it operates as a dynamic cue or antecedent. Ideas only become such when they occur in a reacting system. But any event, occurring in such a system, becomes an idea or thought when it functions for past contexts. In general, the word "stimulus" has no application, except in connection with a "response."

CHAPTER X

PERCEPTION OF SPATIAL SITUATIONS

EXTENSITY

A primary feature of many simple natural events is that to which we apply such names as spread, expanse, or extensity. If coins are pressed against the palm, they do not all "feel alike." The tactile patterns, which are essential constituents of the coins as natural objects, differ in size and magnitude. When we "look at" the coins, that is, encounter the visual patterns which are also intrinsically features of these objects, they, too, display differences in spread or extensity. And the tactile and visual extensity of the coins either coincides with that of the background on which they emerge or else exceeds or falls short of this.

Further, the two patterns, visual and tactile, so often comprise a single context (occur together or in close succession) that the same name or act is readily instigated by either of them. The two thus become "associatively equivalent." Thus "the size of a dollar" is the name given both to the tactile and to the visual spread. Tracing the outline of the seen dollar, with a pencil, and tracing the outline of the felt dollar, involve, again, approximately the same patterns of "movement sensations."

Even to a young child the visual dollar, with its characteristic spread or extensity, becomes linked with definite emotions, as of longing, joy, or awe. And the tactile dollar becomes linked with the same consequents. In such ways there arises an "equivalence" of visual and tactile extensities. We can name or recognize the visual spread to be expected as the

correlate of a given tactile spread, because both, as parts of a single context, become effective cues to a given consequent. Such a consequent may be, for example, a heard or spoken name (auditory or kinæsthetic patterns), a tracing or lifting movement (kinæsthetic pattern), or a characteristic feeling or image.

Such equivalence arises on the basis of prior contexts and sequences. Thus there is a close "correspondence" between the spread of small visual objects and the spread of their correlated tactile patterns on the palm. But if the tactile pattern be unusual or unfamiliar, and not often encountered in context with the spread of a visual pattern, the equivalence is missing. Even in adult life the pressure of a coin on the middle of the back or on the thigh does not have a ready visual equivalent, and this results in perceptual illusion. The instigated response (name, feeling, image) may not be the one evoked by the visual pattern "belonging" to such an object. Since we so seldom see the cavities in our teeth, there is often an astonishing failure of equivalence between the tactile spread of such a cavity (as felt by the tip of the tongue) and the correlated result of visual exploration. Such failure is often called "illusion."

This feature of spread or extensity, which is one of the simplest spatial characteristics of natural objects, is a common attribute of visual and tactile patterns, at least. Whether the patterns of qualities in hearing, taste, smell, and other fields manifest it is disputed. Pains seem to be appropriately described by such terms as sharp, fine, diffuse, and the like. Sounds low in pitch are often said to seem large, voluminous, as compared with higher and shriller tones. But even the most careful observation has not decisively shown whether these characterizations are based on intrinsic and original properties of pains and sounds, or whether they are synæsthetic or perhaps merely figurative reports. Thus, since low voices go with large visual patterns (adults) and higher pitched voices with smaller patterns (children), the pitch features might effectively instigate consequent reports originally dependent on visual extensity.

PATTERNS OF KINÆSTHETIC QUALITY

In the case of kinæsthetic patterns, felt changes correlated with visually observed displacements of parts of the body (as in moving the hand, eyes, head of the reporter), it is also doubtful whether the attribute of extensity occurs. But kinæsthetic patterns are strikingly characterized by the attributes of temporal arrangement, intensity, and rate. Thus, if the forearm move on the elbow joint, there are vivid kinæsthetic patterns which vary in definite ways with the visually observed rate, distance, and direction of the hand movement.

Strains and tensions occur, stretchings and compressions, depending on or in part constituting the activity of muscles, tendons, skin, and there are characteristic "joint sensations" from the play of joint surfaces upon each other. These vary in their character and serial order as a function of the direction of movement; they vary in intensity and speed of succession as a function of the rate of movement and the resistance or load against which the movement works. And if the load is suddenly removed or increased, distinctive and often violent changes in this elaborate kinæsthetic pattern occur.

These patterns of kinæsthetic qualities play an important rôle in the life of organisms, and it is necessary to have at this point a clear account of their status. Kinæsthetic patterns, although composed of this motley array of qualities (skin, joint, muscle, and tendon elements), are definite natural objects. They occur in the same natural realm as do such visual objects as the rainbow and the migraine figures, such auditory objects as the tone and the melody, and such complex and chiefly visual-tactile objects as shoes, bones, muscles, brains, and trees.

What we call "a movement of the hand" is a very complex natural event. It ordinarily comprises at least changes in the visual field (the movement as seen), changes perhaps in the auditory field (the movement as heard), and changes of kinæsthetic pattern. Thus I can see and hear my hand move just as I can see and hear the movement of a chair across the floor. Other reporters also make reasonably consistent reports

of such changes, so that we are likely to suppose that the *actual movement* is exclusively a visual-auditory-tactile affair, a consistently reported and hence "physical" event, in the popular sense of this term.

But I can also "feel" the movement of my hand with eyes closed, and however silently it be made. The characteristic kinæsthetic patterns which arise, for example, when I wiggle my ears or thumbs are, however, known directly *only* to *me*. Others can see and perhaps hear the movement, but only I can *feel* it, through kinæsthesis. But the kinæsthetic events are as much a *part of the movement* as are the visual, auditory, and tactile changes as reported by myself or others. The movement is a complex set of changes in nature, and the "kinæsthetic sensations" or *parts* of this affair are as constituent of it as are the visual and other changes.

It is necessary also to distinguish between movements and differences of position. Finding an object in a new place, I may conjecture that it has moved. But so far as my report is concerned, I have not observed the movement. Seeing my hand in another position I may also infer a previous movement of that member. But it is essential to distinguish between phenomenal movements and inferred movements. A phenomenal movement is describable as a continuous spatial change, and it may occur under circumstances which, otherwise observed, might be very differently described. This happens, for example, in stroboscopic and motion-picture exhibitions.

DISPARATENESS AND SEPARATION

Closely related to the extensity aspect of even the most minute visual and tactile patterns is separation or lateral distance. When the edge of a calling card is pressed gently against the palm, a tactile pattern ordinarily occurs which has a two dimensional spread. The pattern is that of a line, involving a narrowness and an elongation. The ends of this line are felt as separated by an intervening distance or stretch. Or if two points, sufficiently separated visually are stimulated, as by resting the two legs of a compass upon them, these are

felt as discrete tactile items, two points separated by a distance which is relatively unoccupied. In a sense this distance is the spread of the tactual area between the points, although the quality of this intervening background pattern is not, in this case, easily describable.

The case is better illustrated in vision. The two curves, (and) are seen as discrete and separated. Their distance apart is actually the lateral spread or length of the visual pattern (white area and printed word "and") of which these two curves constitute the termini or boundaries, so that the separation or distance of two emergent or outstanding points is in part, at least, a question of the extensity of background patterns upon which or among which these points appear.

Further, if my fingertip is to be made to coincide with, or to obscure now one such point, now another, characteristic kinæsthetic patterns appear. These vary with the points concerned and with their visually noted or "objective" separation. So also in the tactile field, two blisters, one on the thumb and the other on the shoulder, appear visually disparate and separated. My finger may be made to coincide visually with either. But in effecting this coincidence, definite movements must be made, to touch each blister. With each there is consequently associated both a given kinæsthetic pattern (the moving hand and arm) and a given visual pattern (the moving hand and arm). Part of the blister is also a pain quality, for a blister, in nature, is not an exclusively visual affair; it is at least a complex visual-algesic-tactile-spatial pattern. With such patterns or contexts there thus come to be linked definite movements (as in pressing or scratching the blister) and these movements have both visual and kinæsthetic aspects or components.

The shift of kinæsthetic pattern involved in successively touching two points on the hand is less vigorous and pronounced, both in quality and in degree, than the shift involved in successively touching now the back, now the forehead. This is true no matter whether the points in question be visual or painful. Visual, algesic, and tactile separations thus become, as parts of a single context, oft repeated, linked up with

identical movement patterns (seen, felt, or both). They also come to arouse identical names, feelings, and images. And the kinæsthetic patterns and changes of pattern become in turn linked up with and symbolic of just such visual separations, for as these patterns of kinæsthesis change, the visual aspects of the moving hand change in correlated ways.

There is thus involved a complex system of equivalents, in which the visual, tactile, algesic, and kinæsthetic manifolds are mutually and intimately involved, in terms of both extensity and separation or lateral distance. Since socially consistent testimony is restricted to the visual patterns which are "accessible to all," there arises a conventional practice of treating visually apprehended extensity and separation as the objective, the actual, or true and valid space relations. But for individual reporters the kinæsthetic patterns are so definite and from time to time consistent that the motor space relations may be as crucial and determinative as the visual aspects. As we shall see, this is particularly the case when we are concerned not with lateral separation (up and down, side to side) but with distance or third-dimentional depth.

THE PERCEPTION OF SEPARATION

On the basis of this complex incorporation or integration of spreads and separations, such relations in one field (as kinæsthesis) become equivalents of or substitutes for others. As partial antecedents they function for more elaborate or total contexts. The same verbal descriptions or names come to be evoked by them all. With eyes closed, the hand may be moved. In terms of the kinæsthetic patterns which this movement involves or in part is, verbal testimony may be given which applies also to the visual distance which the seen hand would traverse when thus moved. Thus with the eyes closed I can "draw a six-inch line," "move the hand one foot to the right," and so on with not unreasonable error. The *accuracy* of such performances is chiefly a matter of the exactness and precision of the established equivalences. Such equivalence or part-for-whole instigation is, as in other cases,

a function of such factors as the recency, frequency, and general conditions of past contexts, the nature of concurrent and present stimuli, and the like.

Thus if the hand is bearing a variable load, it will be found to make visually shorter excursions for a "six-inch" movement than when the load is lighter. In any unusual or awkward position, as in moving the hand upward behind the back, or in extreme conditions of muscular contraction, the visual distances will also be kinæsthetically exaggerted. It may be said that the extra mass of kinæthesis (intensity or quality) is taken to signify greater visual distance, since such extra kinæsthetic changes ordinarily go with larger visually observed excursions.

Such discrepancies of kinæsthetic and visual equivalence constitute "illusions" and "errors" (constant or variable). They are, psychologically, like the looseness with which children use many words before the more precise equivalence of verbal and other objects is established. They may, like the childish errors in language, be "corrected" or improved by practice, just as with repetition better equivalence of tones and tastes, for salivary secretion, may be established in the case of the experimental dog.

So far as our present account has carried us, then, the spatial world *is* this complex incorporation of spreads and separations, concerned chiefly with visual, tactile, and kinæsthetic objects. That auditory objects (sounds), gustatory objects (tastes), olfactory objects (odors), algesic objects (pains), and so on, contribute little to this system is an interesting but wholly inexplicable fact. The various "modalities" of nature present many such differences. Thus visual patterns as such do not have rhythm; pains lack the elements of harmony and discord so characteristic of tones; and both sights and sounds are relatively lacking in the violent feeling tone that is so immediate a feature of so many tastes and odors, and of most pains.

Nor must it be thought that the kinæsthetic patterns involved are exclusively those arising from manual manipulation. Eye movements, as we successively "fixate" separated

points; head movements, as we turn this way and that in correlation with the varying features of sights, sounds, contacts, pains, are also important. Any bodily movement, gross or delicate, may, as a kinæsthetic or visual pattern, make its contribution to that elaborate system, alphabet, or language in which the spreads and separations of natural objects become, as spatial features, the equivalents or signs of larger antecedent spatial complexities.

DIRECTION

The more elaborate spatial and tactile patterns exhibit not only features of spread and separation but also a very striking set of relations which we call direction. Not only may luminous points be separated and discrete, as well as themselves extended, upon their background. They also occur side by side, above and below, diagonally placed, and so on. On a surface these relations of placement constitute directions from some arbitrarily chosen point of reference. Direction involves always a structure or configuration; thus "above" means only related in a given way to something else. Position and direction are thus always relative and involve points or axes of reference. On a plane surface, two arbitrarily chosen dimensions or sets of coördinates serve to establish the "locus" of any point upon that surface. But such a procedure is only a technical convenience, and one set of dimensions is little better than any other. The vertical and horizontal dimensions seem to have been chosen on the analogy of the two more striking axes of the human body.

Again the fields of kinæsthetic, tactile, and visual objects or patterns comprise contexts, and with practice one becomes the surrogate for the others. The following simple example will illustrate this situation more concretely.

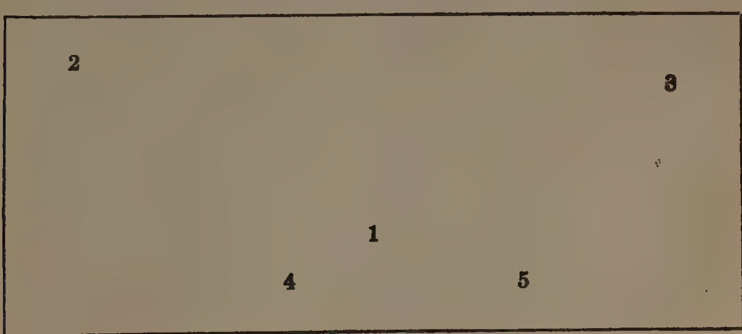
While fixating the number 1 in the rectangle opposite, the other numbers are also seen. They are characterized by different degrees of clearness (1 is distinct, 4 is less so, 2 is very obscure), by different directions from the fixation point, and by different separations from this point. Primarily these

seem to be original features of any visual manifold. But 2 becomes clear if I shift my eyes to it, whereupon 1 becomes vague and 5 very obscure. So with 1 as an initial fixation point, there is, corresponding to each visual direction and separation, a definite set of eye movements which will clarify the details of each number, enabling me to discern their parts, to name them, and so on.

And, with my finger placed on 1, thus covering it, there is for each of the other numbers a definite manual movement which will place my finger upon each, thus concealing them in turn. Correlated with my eye movements and hand movements (as visually observed by others or by myself, or photographically recorded) there are kinæsthetic patterns, which may be most clearly observed by moving hand or eyes in the dark.

Although such kinæsthetic patterns may possess little or none of the attributes of direction, they are each unique temporal and qualitative complexes. The movements as seen have aspects of direction similar to the direction features of the visual numbers. And if these numbers were engraved, rather than printed, definite tactile patterns would arise as the seen finger pressed upon and obscured the seen forms.

Again then, we have a complex incorporation of redintegrative equivalents. Any part of the complex may be substituted for the total context. The visual direction becomes the sign of a definite motor activity; it *means* a given eye movement if clear vision is to result, a given hand movement



if the form concerned is to be concealed. And the movement involved may be either a spatially organized pattern (as seen) or a qualitatively, intensively, and temporarily organized pattern (as felt).

LOCALIZATION OF SOUNDS AND ODORS

Even sounds and smells participate in this organization of directions, in so far as by turning the head or by shifting the rose or bell held in the hand, the intensity and quality of tone or odor may be varied. Just as we "look at" number 5, in the foregoing illustration, shifting the eyes from their original fixation, so we "turn toward" sounds, that is, we make whatever adjustments are found to increase the clearness of the object concerned. This is especially true since, having ears on opposite sides of the head, there will be phase differences and intensity differences if one ear is nearer the "source" of the sound, or if one ear is less acute than the other.

Ordinarily, in observing auditory objects, we turn the head so that these differences disappear, and so that the sound intensity is maximal. The reported direction of the sound is then usually that of the direction in which we face. As in the case of the other senses, curious illusions (discrepancies of sight and sound, or inconsistent testimony of different reporters) may be produced by experimentally varying the effective cues. Thus if the sound of a tuning fork in another room be communicated to my two ears only through the two unequal sections of a rubber tubing which extends from one ear into the sound room and then back to my other ear, the fork will be louder for one ear than for the other. And depending on the position of the fork on the tube, the sound will be falsely located. The error in my report may be varied by changing the relative length of the two sections of tubing leading to my two respective ears, for ordinarily, if a sound is somewhat louder in the right ear it comes from the right side. Phase differences, as we have said, may be similarly effective in modifying the report of direction.

If a snapper be clicked directly before, behind, or above me,

and the room is of such size that echoes do not give distinctive clues, and my eyes are closed so as to avoid visual clues, I am unable to locate or point to the sound with any considerable accuracy unless the sound is prolonged and I am permitted to turn my head in an exploratory fashion. But clicks produced on either side of this median line are promptly and with considerable accuracy located so far as direction is concerned.

The ventriloquist is simply an entertainer who can easily modify the loudness and quality of his voice (now a Jack, now a Jill voice) and who cleverly plays upon this difficulty of sound localization. He stands immediately in front of his audience (in or near the median line) and by gesture, direction of gaze, and the manipulation of his puppets, offers *visual* clues which mislead the auditors in their reports of the direction of the sounds he produces. The skillful ventriloquist is thus an adept in taking advantage of the redintegrative mode of sequence, just as is the actress who deftly reënforces the redintegrative potency of her lines by cues of gesture, posture, and facial expression.

VISUAL PERCEPTION OF DEPTH OR DISTANCE

The most interesting field of space perception is that in which the third dimension is involved. This is primarily separation from the reporter's body, some things being close to it, others more remote. Secondarily it comes to be also separation of other things one from another, along a line running from the reporter's body in their general direction. From the behavior of very young infants and of those born blind who have later acquired vision through some operation upon their eyes, it appears that depth or distance away from the observer is not a primary feature of visual objects. Although visual clues speedily become adequate surrogates for such a spatial situation, this adequacy must be *acquired,* on the basis of frequent redintegrative sequences.

Distance from one seems primarily to be a motor affair. Things are "farther away" in the sense, originally, that I

must make more effort, take more steps, or consume more time in getting to them. If, as a young infant, I reach for the moon as I have reached for mother's face and father's watch, this is merely because no visual clue is yet available to determine such reaching movements, except in direction. Clues for direction may be already established, but these also, at least in the case of human beings, must apparently be learned. In the case of other animals, as in the pecking of chicks, the evidence is disputed or variously interpreted. That nature does not occur on a two dimensional plane, but that at least three conventional axes are required to represent its character, is again an important but wholly inexplicable fact.

In response to sights, sounds, and other objects, movements occur—the familiar sequence of antecedent and consequent. In the beginning these seem to be chiefly if not entirely physical occurrences, that is, reflexes. The movements involved often persist until some change is effected in the stimulus. An infant struggles toward a seen object until he can get it between his gums. Distance primarily means amount of kinæsthesis involved in "getting to" the object. Among simple folk, distance continues to be described in terms of the labor involved in traversing it—as in "a three days' journey."

But in the situation as a whole many other clues, especially visual clues, become effective as partial features. Thus as I move an object close to my face, or as I get closer to it, it obscures more and more of the background. It increases in apparent size, in relative visual spread or magnitude. Men far away look tiny; as I approach them they obscure more and more of the objects beyond them, they swell in relative spread. This apparent size of similiar objects readily becomes a sign of the amount of motor activity (kinæsthesis) involved in reaching them.

With practice the apparent size (a visual clue) serves to touch off consequents appropriate to the whole spatial situation as it has previously occurred. I see the tiny figures of the trees across the lake and at once "my heart sinks" or I say "Too far for me to swim," or "I would play out before

I got there." I see the large apple form, on a projecting bough, and at once I exult, "I can reach that one." The visual clue becomes a symbol for the whole situation, in terms of past contexts of a similar kind in which such clues have been partial features.

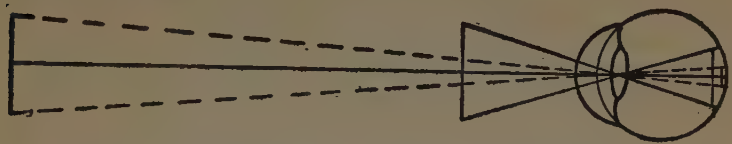


FIG. 9.—IF TACTILE-MOTOR SIZE IS KNOWN, VISUAL SPREAD MAY BE USED AS A SIGN OF DISTANCE; THE OPTICAL IMAGE SHRINKS AS THE OBJECT RECEDES.

On such occasions I may say that "I see the distance," just as in the chapter on Perception I said that I heard the postman coming. One of these assertions is as true as the other. In both cases a clue instigated consequents appropriate to a larger setting, of which that clue had often been a partial

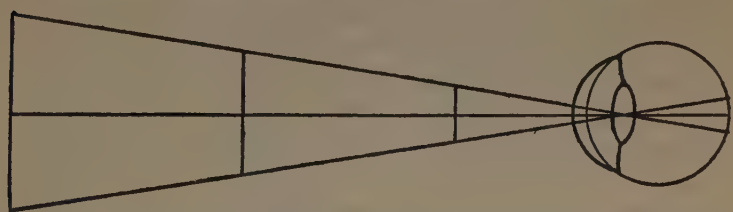


FIG. 10.—IF TACTILE-MOTOR SIZE IS UNKNOWN, VISUAL SPREAD CANNOT BE USED AS A SIGN OF DISTANCE; OBJECTS OF DIFFERENT TACTILE-MOTOR MAGNITUDES, AT DIFFERENT DISTANCES, GIVE THE SAME OPTICAL IMAGE.

detail. It is just this way that the water *looks* cold, the wind *feels* bitter, and the neurotic soldier *trembles* at the sound of the slamming door.

Obviously the situation is actually much more complex than this, for we have isolated one factor from its context. The description we have given is valid, provided the objects are familiar, that is provided their tactile-motor size is known. Then visual spread may reliably be used as a sign

of distance. But if the tactile-motor size of the object is unknown, visual spread is an unreliable sign, since objects of different magnitudes, at different distances, may have the same visual spread. In such a case, other cues to distance must be relied on. It also follows that, if both distance and visual spread are known, these two facts together may be used as an indication of the actual, that is the tactile-motor, size of the object. If we already know the distance of a tree, and note how large it *looks*, we can with these data estimate the labor of climbing it. But this again is only true in so far as both data have been details of past contexts.

MONOCULAR SPACE PERCEPTION

If we confine our account to monocular perception, there are, nevertheless, very many clues which, along with relative spread or apparent size, serve to guide conduct and report. Thus, on the ground, far objects appear higher in the visual field, near objects lower. In the sky the situation is the reverse. Near objects appear with clear details; remote objects are blurred, hazy, and in general bluish. In unfamiliar circumstances such clues may lead astray. On a particularly clear morning, for example, strangers in a mountain region are often instigated to walk to an interesting peak and back before breakfast. After hours of disappointing effort they may learn that the distance to the peak is really "a day's journey." Near objects also partially or wholly intercept or obscure the view of objects beyond them. Objects nearer than a given point of regard (optical fixation) seem to move to the right when the head turns to the left, while objects beyond the fixation point move with the head (parallax).

Many of these monocular clues the artist employs in "suggesting" distance on the canvas. The diminishing size of objects as they recede gives his lines of perspective, meeting at the vanishing point. He varies the size, the color, the detail, the elevation on the canvas, allows some objects to overlap, and so on. The best way to realize that the depth apparently present in the visual field is only redintegratively there is to

note the success with which the mural decorator "creates distance" on his flat canvas or the wall of a room. When "the illusion is perfect," this means that the visual details presented function adequately for larger contexts such as those in which such details have formerly participated.

There are also kinæsthetic processes or events which may serve as signs of the amount of reaching and locomotion required to get to a given object. Thus the ciliary muscle, in the eyeball, when it contracts, releases the lens from the pull of other structures and permits it to bulge. Thus it becomes more convex and optically "stronger." When this muscle

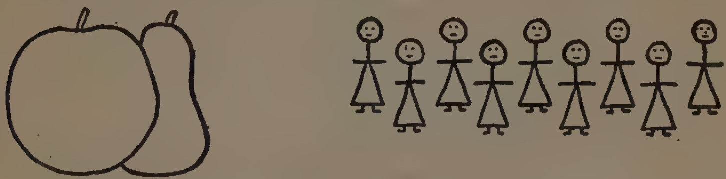


FIG. 11.—INTERCEPTED OBJECTS, AND THOSE HIGHER IN THE VISUAL FIELD, APPEAR MORE REMOTE.
Adapted from Smith and Guthrie, *General Psychology in Terms of Behavior* (D. Appleton and Company, 1921).

relaxes the lens is flattened by the effective pull of other structures and becomes optically "weaker." For near objects a more convex lens is required, for purely optical reasons.

These muscular activities can be "seen" by the optician who visually explores my eye. They can be "felt" by me, to whom they appear as a characteristic pattern of strain and kinæsthesis as I look back and forth, that is, *accommodate* now for that object, now for this. This mechanism of accommodation thus affords kinæsthetic clues which may also serve as signs for the amount of distance between me and another object, or between one object and another more remote or nearer. So slight, indeed, are these kinæsthetic clues that most people have not even identified them and named them. They ordinarily serve *only* as signs, hastily moved over, to the more vital consequents which they assist in instigating,

just as the misspelling of words may easily be overlooked in reading.

It will be observed that no mention has been made of the "retinal images" which ordinarily play so large a rôle in the accounts of monocular space perception. The optician assures me that a condition of my observing visual objects is the formation of such a retinal image in my eye. If he is right (and of course he is) we have here encountered an interesting fact with far-reaching systematic implications. For so far as I am concerned, I have no retinal images. Instead, I have visual objects in the world about me. I encounter only trees, houses, clouds, and similar visual-spatial patterns and these are not in my eye, but in nature, where my eye also is. If there are also optical images on my retina, they are excluded from that part of nature which I can report on the basis of direct encounter.

Apparently, then, there are not only natural events (pains, mental imagery, migraine figures, and the like) which I alone can report, but also natural events which I alone *cannot* report. The privacy of nature seems thus fairly distributed, and it is far from clear why the pains which I alone confront should be called psychic or subjective, any more than these secret optical images on my retina, which I never encounter and cannot "see."

The fact is, of course, that we are again face to face with the social character of nature as a system. The optician reports my retinal image when he looks at my eye. But I report, instead, whatever object is in my visual field, say the rainbow. Now it is important that these two reports have such a close correlation, and equally important that nothing is there but correlation. When I report that the rainbow has gone, he is also forced to acknowledge that the optical image he was observing has disappeared. The correlation is as significant in one direction as in the other.

The account of nature must, however, be a *joint report,* in which the optician's testimony and mine are equally valid. To suppose that what he sees (and I cannot) is real, while what I see (and he cannot) is "mere consciousness," may flatter the optician, but it perverts the description of nature.

The process of vision may be described either in terms of what I see when I look at the sky, or in terms of what the optician sees while peering into my eye. Both of us are confronting nature, but different sections of it, and all that science can do is to accept the two reports and study their correlations.

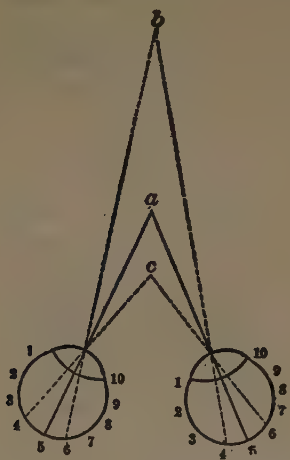


FIG. 12.—WHILE FIXATING "A" IT IS SEEN SINGLY WHILE "B" AND "C" ARE SEEN DOUBLED, BECAUSE THEIR RESPECTIVE OPTICAL IMAGES DO NOT FALL ON CORRESPONDING POINTS OF THE RETINA.

BINOCULAR SPACE PERCEPTION

When the two eyes are employed, certain other space clues, both visual and kinæsthetic, are afforded. A full understanding of some of these involves knowledge of the correlated facts relating to the properties of an optical system, such as that of the eye. Although these optical facts are often confused with psychology and dwelt upon in detail, we need not commit the confusion again in this volume. The reader interested in the mechanics of optical systems and in the physiology of the retina will find these richly described in volumes on physiological optics, such as the three volume translation of the classic work by Helmholtz.

An object in the visual field may be seen either singly or as a pair of approximately but not precisely identical twins.

Look at a picture across the room, meanwhile holding up a pencil in line with it, about a foot in front of the face. When the picture is fixated it is seen singly, and the pencil is observed to be a pair of twin pencils, an inch or two apart. When the right eye is closed the left pencil disappears; the right pencil goes when the left eye closes. Looking at the pencil the observer sees the picture double; each picture belonging to the eye on the corresponding side.

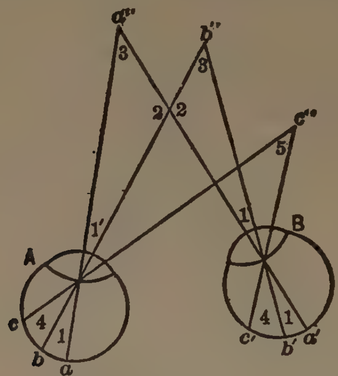


FIG. 13.—SHOWING THE CONDITIONS UNDER WHICH VARIOUS OBJECTS MAY BE SEEN SINGLY WITH A GIVEN FIXATION: WITH BOTH EYES DIRECTED AT A″, POINTS B″ AND C″ ARE ALSO SEEN SINGLY, SINCE THEIR OPTICAL IMAGES FALL ON CORRESPONDING RETINAL REGIONS.

If now, while fixating the picture, the twin pencils are incidentally noted, it will be observed that as the pencil is moved closer to the face its twin members separate more widely. As the pencil recedes toward the picture, the twin members approach increasingly close to each other. At the distance of the picture (with the fixation unchanged) the twin pencils would coincide and appear as one. While fixating the picture, therefore, the amount of separation of the twin pencils might easily come to serve as a sign of the distance of the pencil, either from the observer or from the picture, just as the apparent size does in either monocular or binocular vision.

Further, if a small, solid, and variously marked or colored object, such as a small match box, be substituted for the pencil, it will be observed that the twin boxes are not

entirely alike. One eye sees more of one side, the other eye more of the other side. If the box is held in certain positions the two appearances differ greatly in pattern and configuration. Moreover, as the box recedes toward the picture, the two patterns become increasingly similar. Across the room the box may look the same to both eyes. The amount of unlikeness (disparity) of these twin images may, therefore, also serve as a cue to distance.

Again, the twin images may be made to coincide by fixating the box instead of the picture. This is done by a convergence of the eyes, each turning inward in changing from far to near fixation. At any given distance then, while the picture is being fixated, to combine the twin boxes into one involves a definite set of eye movements in which at least twelve muscles are concerned, six for each eye. The movements are not only made but are also felt (kinæsthesis). These convergence and divergence patterns may thus also afford an array of kinæsthetic clues which adequately serve as signs of distance.

The unlikeness of the two seen match boxes arises from the fact that the box as a natural object has a depth dimension, and from the fact that the two eyes, being somewhat differently placed, have two different points of view. A camera placed at two such points would also give slightly different photographs, each flat and only two dimensional. If two such photographs are placed before the respective eyes, as in using a stereoscope, the various parts of the photographed scene will stand out in a third dimension with startling effectiveness. The cues alone function adequately in instigating whatever constitutes the response to the depth dimension. The "illusion" may be increased by exaggerating somewhat the differences between the two views. In such a case many distance cues coöperate. Many monocular cues are present—size, elevation in the field, clearness and detail, overlapping objects—so that even to one eye the photograph acquires depth, especially if surrounding objects are excluded from view. And all three of the binocular cues, separation, disparateness, and activities of convergence, are present in the stereoscope inspection as twin objects in the two photographs are observed or made to combine.

Distance, then, is primarily a motor affair, a complicated array of kinæsthetic patterns, with such consequents as fatigue, aversion, regret, joy, elation, satisfaction, acts of identification and naming, complex organic patterns correlated with bodily attitudes and perhaps also with varieties of mental imagery. In subsequent sequences the visual, auditory, or ocular kinæsthetic details act as surrogates for the initial kinæsthetic complexity.

TACTUAL LOCALIZATION AND THE RÔLE OF IMAGERY

The spatial cues of distance need not arouse imagery, any more than is the case with any other of the redintegrative situations we have described. But imagery *may* occur, as part of the instigated consequent, and in this sense constitute part of the response to spatial situations. Thus suppose I am touched at a given spot on the hand, with eyes closed, and am required to retouch or to describe this spot, with eyes either closed or open. Upon the occurrence of the touch I often find a very vague and apparently visual outline of the hand, appearing in imaginal form. One or another part of the imaged hand is likely to be more prominent or clear than the rest, this part corresponding approximately to the region touched. There are also movements, often tentative only, in the part itself (as thumb or finger). Names occur, either actually or in silent speech or imaginally (as "thumb," "finger," "right," "left"). Orientations of the eyes, appropriate to visual fixation, occur. Sometimes pronounced feelings, as of embarrassment or shame, arise, if the touch is on a vestigial wart or a badly bitten finger nail. And more or less definitely organized muscular activities, as of the other hand and arm occur, which when executed lead to an approximate retouching of the spot. All these consequents have had an elaborate history, reaching back even before those early days when the removal of an irritating burr, insect, or itch was accomplished by a frantic array of movements eventuating in successful retouching of the spot. They are now instigated by subtle features of the touch pattern itself—differences in the intensity,

the quality, the spread, and other features, such as observably distinguish touches on such variant regions as nail, joint, hair, vein, cold, warm or pain spot, calloused area, and so on.

So facile have these processes (in all space perception) become in adult life, and so slight are the cues now effective, and so engrossed are we with the consequents rather than with the signs themselves, that special effort and skill are required to describe even the cruder events in space perception. Many of the processes completely elude observation of an analytic and naming sort, showing themselves only in their outcome or consequents. These are often only synonyms for the larger complexities for which the cues function. But experimentally depriving the individual of one type of cue, or artificially reducing or exaggerating it, will often serve to indicate the importance of features not easily isolated.

PERCEPTUAL ILLUSIONS

Many "spatial illusions" are thus produced by experimentally manipulating or altering the cues ordinarily relied on, or placing them in unusual or unfamiliar contexts. In some cases adjustment and correction are easy. In other cases the instigative power of the cues is so strong that readjustment to them is difficult or even impossible.

Thus one can, with fair accuracy, hit with a pencil a dot on a sheet of paper placed on the table. Let this be done a number of times. Then introduce a prism through which the dot is seen displaced to the left. Attempts now made to strike the dot, with brisk and unfaltering movements, go astray; they are made too far to the left. But repeated trials serve to recoördinate visual and motor patterns, and accuracy is again achieved.

Now suddenly remove the prism, and the strokes are for some time too far to the right; the newly acquired coördination persists and leads to errors of just the opposite kind to those made when the prism was first introduced. But this time in a very few trials this new adjustment is overcome and the original accuracy reëstablished. Recovery from the new

and little practiced coördination is much easier than was the overcoming of the old and long practiced one.

Psychology and physiological optics have accumulated a vast stock of characteristic "visual illusions," in which the visually instigated estimate of lengths, angles, areas, distances, and directions contradicts the tactile or kinæsthetic estimate, or the results of measurement or of visual observation under other conditions. Collections of such illusions may be found in almost any laboratory or textbook of psychology or optics. Their analysis, measurement, and classification throw interesting light on the great complexity of the cues and consequents involved in the recognition of spatial situations.

Fig. 14.—The famous Müller-Lyer illusion: compare the lengths of the two winged lines.

Another familiar instance is the size-weight illusion. Blocks of the same material, color, and objective weight are constructed and variously loaded so that they differ in size only. When these are lifted, the larger blocks invariably seem lighter than do smaller ones of equal or even of considerably less weight. Study of the lifting movements shows that a more vigorous lift is given the larger blocks, which thus spring up into the air with a surprising ease and give the effect of lightness. For lightness of course is also relative, relative for example to the strength and preparation involved in the lifting movement. It thus appears that even in visually regarding an object we prepare to lift it; at least we take a general attitude, however tentative, appropriate to the motor manipulation of such an object.

Our cues for such preparation include, especially if objects are otherwise visually similar and nothing more is known about them, the size or spread of the visual pattern. Even what may seem to be merely a passive visual examination of

a pattern thus really involves motor sets and adjustments, instigated by such features as visual spread or magnitude, in terms of past motor manipulations of other objects differing in similar ways.

The process of recognizing spatial situations is one of the most fruitful fields for psychological analysis. Its very difficulty and the subtlety of the cues and consequents which it involves, give it an added fascination for the psychologist. And nowhere, unless perhaps in language, will there be found

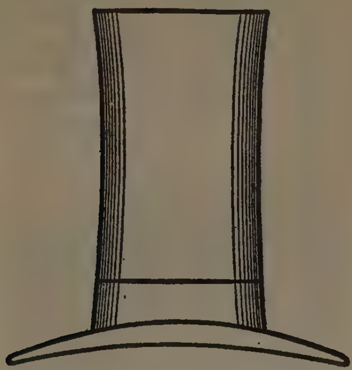


FIG. 15.—IN COMPARING VERTICAL AND HORIZONTAL DIMENSIONS VISUALLY, THE FORMER IS OVERESTIMATED.
From Luckiesch, *Visual Illusions and Their Applications*.

neater occasions for the application of the mental paradigm, or more striking instances of the astonishing range and facility of redintegrative instigation.

THE PSYCHOLOGY OF ILLUSION

Illusions are to be found in many fields and often many factors contribute toward their production. Aberrations or unusual conditions in the sense organ or in extra-bodily influences may be important. Thus in the case of vision the introduction of the prism produces an illusory appearance of objects seen through it, and crooked mirrors distort the images reflected from them. But the most common factor is

a strictly psychological one. It consists in the arousal of a response or report by some prepotent cue, which outweighs the other available evidence. This may be due to the recency of or preoccupation with some context, to the readiness of a particular response, to the outstanding character of some

FIG. 16.—THE LEGS ARE STRAIGHT IF OBSERVED WITHOUT REFERENCE TO THEIR BACKGROUND OR CONTEXT. EXAMINE EACH LINE SEPARATELY, OR RAISE THE BOTTOM OF THE BOOK TO A LEVEL WITH THE EYES AND SIGHT ALONG THE LEGS.

presented detail, or to the neglect of certain details in the present situation.

In all these cases the illusion consists, in fact, of an interpretation that is not warranted by closer inspection or by social or more complete report. The neurotic soldier, the dog of Pavlow, the synæsthesia, the student who read the meaningless inscription as "button," the ventriloquist's tech-

nique, also represent cases of illusion. For the responses there made to outstanding details were inconsistent with the results of closer inspection. A single detail, acting for *past* contexts, was so effective, prompt, and coercive in its instigation that accompanying details of the present context were of no avail.

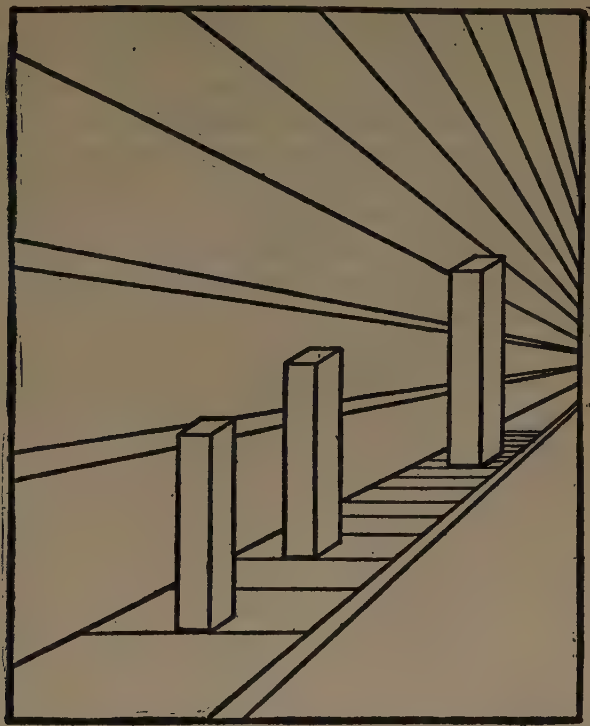


FIG. 17.—DECEPTIVE APPEARANCE OF SIZE THROUGH THE SUGGESTION OF PERSPECTIVE LINES.

Many spatial illusions may be analyzed so as to exhibit this prepotent influence of particular details. Thus the white areas surrounding two equal black lines may be so conspicuously unequal as to determine a judgment that is applied to the lines themselves. The greater effort involved in optically exploring a vertical line may lead to its being judged longer than a horizontal line of equal objective length. The

perspective suggestion of lines converging in the background may give deceptive appearance to transverse lines which, but for the perspective suggestion, would appear alike. In many such spatial illusions there are, no doubt, varied influences which jointly contribute to the observed effect.

The typical illusion thus represents an "unsagacious" response, since it does not take advantage of all the evidence afforded by the present context. Past learning is too effective for present controls—a situation which will be of special importance in the discussion of intelligence. Aside from this factor of prepotency, there is nothing distinctively psychological about an illusion. The process is that involved in all perception. It is only from the point of view of some practical or social consequence that the element of illusion arises, when the momentary report does not agree with the verdict of fuller investigation.

CHAPTER XI

SOCIAL ASPECTS OF PERCEPTION

THE RANGE OF SOCIAL PERCEPTION

It would be misleading to limit our study of the process of sign interpretation merely to such formal and standardized fields as those of space, language, and the identification of objects. Most of what is distinctive in human life involves the process of perception, of reacting to signs or parts as if the whole were present. Even when the signs are not "authentic," when they are not capable of reliable use as symbols, such interpretations are, nevertheless, often attempted. When reliable signs fail, we utilize such indications as may be available. One of the problems in the field of social perception is that of discovering just what signs are valid and to what degree and under what circumstances they lead to profitable consequents.

Through symbols, as of the weather, the condition of soil, the prosperity of his fields, the farmer adjusts his day's work; by the aid of signs the mariner sets his course. The business man stakes large investments on the accuracy of his interpretation of signs. The significance of symptoms guides the physician, and on the features of his perception the life and happiness of the patient and his family depend. The statesman determines the course of history and the welfare of peoples by the way in which he reads the signs of national and international conduct. Each of us steers his conversation, his gifts, his business transactions, his choice of friends, his selection of a life mate, by reliance on signs.

As signs, these have been details of past situations, and for such complexities they now function. The situations may have been encountered immediately in life, or indirectly,

through other symbols, as in reading or other forms of vicarious experience. It will be profitable to investigate the way in which mental or redintegrative processes operate, therefore, in such a field as social perception. We mean by social perception the recognition of various unstandardized signs afforded by our neighbors. Such signs as stammering, blushing, facial expression, starting, hesitation, furtiveness of glance, cordiality of speech, tone of voice, direction of gaze, steadiness of visual fixation, illustrate the type of sign here meant.

Such signs may be used as clues to acts which the individual has already committed, as in the detection of guilt or deception. They may indicate "subjective events," such as present images, moods, intentions, fears, or sorrows, which the individual does not report through more standardized media, such as speech and writing. Or they may be used as signs of character or of conduct. In the former case, they refer to the general probability of acts of a certain sort, as kindness, theft, coöperation. In the latter case, they refer to more specifically contemplated acts, such as voting for me, or loaning me the money I need, or whipping me for going in swimming.

In such cases the signs used may have been features of this particular individual in past situations in which more complete or overt conduct or report has been involved. We now react to them as we reacted to those antecedent complexities. Or the details may be, instead, common features of situations in which other people or other animals have been concerned, and we now take them to be signs of what we vaguely call "human nature in general," or "animal nature."

THE INTERPRETATION OF FACIAL EXPRESSION

As we shall see more fully in the chapter on feeling and emotion, subjectively known feelings are at least in a general way correlated with objectively known bodily changes. In the case of animals lacking standardized media of communication and report, it may be safer to apply such terms as "friendliness" and "animosity" merely to the visually observed bodily

activity. But in the case of human beings, each of us individually knows that his bodily conduct as it appears to the vision and hearing of his neighbors is correlated with other events known only to the actor. To such events we give the names feeling, emotion, mood, intention, and the like. Sometimes the verbal reports of others indicate a like correlation in their case. We are not now concerned with the fact and significance of such correlation. Instead we are interested in the use of the one as the sign of the other. Even if, with the behaviorists, we are skeptical of the existence of facts accessible to but one reporter, we may use such present acts as the sign of more elaborate acts to be observed on later occasions.

We cannot within our space limits discuss all that is known of the interpretation of such signs. We may first single out, as one on which definite experimental work has been done, the interpretation of facial expression. If the reader will turn to the pictures in Figure 18 with the question, in each case, "How does she feel?" he will find himself making ready replies. In one case, she feels happy. In another she feels angry or astonished, or afraid, and so on. The evidence for the general tendency toward "correctness" of these interpretations by adults is shown by the degree to which we successfully guide our conduct by them, at least in some of the more "striking" cases.

We may prepare the way for the following chapter on Learning by showing at once that these interpretations are not "native," but are acquired by us on the basis of past contexts. If our reactions to facial expressions, as signs of subjective events, were native, we should expect children of all ages to succeed or to agree in such interpretations. The particular results would, of course, depend on the particular expressions chosen and the particular photograph given or aspect presented by this expression. The expression as it is given in the photograph is only a cross section—a partial feature—even of the unit of facial expression. For the unit is a series of facial changes in time, beginning with one step, advancing to a further change, and quickly or slowly making further changes. Instead of taking a "whole expression" then, we have here

adopted merely a "fragment" of such a series. And we inquire to what degree this fragment instigates the same act of identification in children of different ages as it does in the sophisticated adult who is taken as the best available standard.

Several studies of this sort have been made, and the materials constitute a stock experiment in many laboratories of psychological instruction. In one case [1] the pictures reproduced in Figure 18 were presented one at a time to 458 children, ranging in age from 3 to 14 years and in school status from kindergarten to the sixth grade. With each picture the child was asked, "What is she thinking about?" or "How does she feel?" or "What is she doing?" The cross section of facial expression is thus given opportunity to function as a sign of more elaborate situations to which names have also been attached. The subject is invited to give another symbol for, to name, or to describe antecedent contexts of which such a facial expression has been a feature. It is a typical perceptual situation; the given cue is to instigate or not to instigate a response appropriate to the total complexity.

All that is recorded by way of response is the verbal name or description that is provoked. What images, feelings, attitudes, or other adjustments occurred were not investigated. But observation of such experiments is instructive. The subject often makes facial expressions resembling those of the picture. Gestures are made, as with the hands, which often go with such expressions. Images or other symbols for people and events occur, as of a certain friend or acquaintance, of whose facial expressions these are typical. Immediate feelings are faintly aroused, similar to those one would have before a living person with such an expression. Feelings are aroused by the postures which the subject himself assumes, or the immediate kinæsthetic aspects of these postures are reported as "feelings." The name or verbal description is, therefore, only part of what occurs. One lives himself

[1] See, for example, Georgina S. Gates, "An Experimental Study of the Growth of Social Perception," *Journal of Educational Psychology*, November, 1923; and "A Preliminary Study of a Test for Social Perception," *ibid.*, October, 1925.

Joyousness

Anger

Astonishment

Startled fear

Scorn

Anguish

FIG. 18.—PHOTOGRAPHS FOR AN EXPERIMENT ON SOCIAL PERCEPTION.

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into (empathy) the situation for which the expression stands. But such complexity of response is characteristic of much of perception.

SOME EXPERIMENTAL RESULTS

The children's replies show various levels of interpretation. The answers of kindergarten children in the case of picture C (anger) may be used to indicate these degrees of understanding. "Anger," which is agreed by adults to be the "meaning" of this expression, is, of course, not merely the name of the "look." It would be applied also to tones of voice, gesticulation, words, and other details of the elaborate situation for which it stands. Only about one-third of kindergarten children correctly identify the social significance or emotional expressiveness of this picture.

When valid social perception occurs, the response is some such reply as "She is mad," "She is angry," "She looks furious," "She is an angry naughty lady," "She is thinking about something mad," "She is cross," "She sees something bad." Some give, instead, literal descriptions, as: "She is opening her eyes," "She sees me," "She is making a face." Others give fanciful interpretations which, however, lack social import, as: "She sees a bird," "Sees a rat," "Looking at a picture." Others say, "I don't know"; still others reply more or less irrelevantly, as: "Not laughing," "Walking," "Sitting."

For the majority of kindergarten children, therefore, this photograph is not an adequate cue for a name which is quite early learned for a more elaborate context. No doubt the constellation of several cues, as by adding gesture, voice sounds or words, might enable those to succeed who fail when the picture is the sole detail. It is, moreover, likely that when the name fails, other features of the co-response are missing also, or are in error. Superior capacity for such interpretation is undoubtedly a factor in enabling the individual to make prompt and effective social adjustments to the moods and intentions of others.

Such success increases as a function of age, presumably because of the accumulation of experience (past contexts)

through the technique of learning. In the following table the percentage of successful responses for children in different school grades is given for each of the six pictures here shown. It is clear that the pictures have different degrees of "difficulty," which are overcome with advancing age. Thus in any grade laughter is correctly identified by many, wonder by few and the others by intermediate numbers. For any given picture the correct responses increase with the age or school status of the children.

TABLE V

PERCENTAGES OF SUCCESSFUL RESPONSES GIVEN BY DIFFERENT GRADES IN EXPERIMENT ON SOCIAL PERCEPTION

(From G. S. Gates, "An Experimental Study of Social Perception," *Journal of Educational Psychology*, November, 1923, p. 461)

Grade	Kindergarten	First Grade	Second Grade	Third Grade	Fourth Grade	Fifth Grade	Sixth Grade
Cases	67	43	58	60	42	23	81
Laughter	77	93	95	83	100	100	100
Pain	46	67	60	51	74	78	91
Anger	22	35	45	61	83	78	81
Fear	13	11	08	28	64	83	85
Scorn	00	00	02	08	17	43	41
Wonder	00	00	00	00	04	30	65

Ages	*Average Number Correct*
3–4	1.65
5–6	1.95
7–8	2.50
9–10	3.80
11–12	4.50
Adults	6.00

The conclusion on this point, as stated by Gates, is as follows: "The laughter picture was understood by more than half of the children whose age at last birthday was 3; anger at 7; fear at 10; surprise at 11; while scorn was described by only 43 per cent of the 11 year old children." Individual children may be "measured" by noting the number of correct responses, of the possible six, and comparing this number with

the standards for ages and grades. On this basis the average scores are useful in estimating the status of individuals. These averages, on an age basis, follow Table V above.

Such individual scores correlate, in the groups studied, only slightly with chronological age (+.31), mental age (+.12), and physical maturity (+.26). With teachers' estimates of ability to coöperate (+.42), to persevere in a project (+.60), and to control emotional reactions (+.50) the correlations are reasonably close. The experiment thus serves both to illustrate the nature and process of social perception and to indicate its important rôle as at least one of the factors in social effectiveness.

TRIVIAL SIGNS OF HUMAN CHARACTER[2]

As we identify the individual's mood from the cue of facial expression, so we often report his general character on the basis of fragments or details. We do not refer to the ridiculous and arbitrary "systems" of character analysis that are sold and practiced by fakers of many kinds. We mean that definite perceptual process whereby our attitude toward or estimate of an individual is touched off by relatively slight details of his appearance or behavior. Here there have been past contexts which give the present detail its potency, contexts either lived through or encountered vicariously in books or in similar ways.

Thus character is often estimated from signs afforded by the appearance, vocabulary, grammar, and other details of letters written by applicants. Studies of such results have been made, in which neatness, reliability, tact, and intelligence were thus reported by different judges. The letters that some judges would have chosen as most favorable, others would have thrown with equal confidence into the wastebasket. And when the same men judged the same letters a month later, they were no more consistent with their former reports than with those of other men. In the face of such disagree-

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[2] See H. L. Hollingworth, *Judging Human Character* (D. Appleton and Company, 1922), for detailed reports and discussion of many studies such as those here briefly indicated.

ment it is clear that such clues do not lead to consistent reports and are, therefore, unreliable signs. Nevertheless, in each man the reports were undoubtedly based on at least one or more past contexts.

PHOTOGRAPHS AS CUES TO CHARACTER

Photographs of the face "at rest" are also often used as signs of human character. In such cases the perceptual process is often clearly exhibited. The photograph resembles that of some one we have known intimately. This slight resemblance is enough to touch off a verdict such as would be appropriate to this former context. The context may even have been the photograph of some historic personage or the verbally described hero or villain of a novel. Experimental comparisons have been made of character reports by strangers based on photographs, with reports given by intimate associates on the basis of prolonged acquaintance. The latter is perhaps as reliable an index of character as we can now secure.

The results show that the individual perception is again fallible. Individual estimates based on photographs show such slight accord (correlation) with the estimates of a group of close friends and associates that they are useless. If, however, the verdicts of as many as twenty-five people are combined, the results tend definitely to agree with the criterion. With such traits as neatness, conceit, sociability, humor, and likableness the correspondence is so low as to make even such a consensus useless. In the case of intelligence, refinement, beauty, snobbishness, and vulgarity the correlation is high enough to be very suggestive.

There is a twofold basis for such results. On the one hand the acquaintances also probably used the "appearance" of the individuals as partial data for their judgments of some traits. Furthermore, it is quite likely that such traits as snobbishness, intelligence, and so on lead to chronic and characteristic facial expressions and sets, in adults. If so, in the consensus of opinion these cues might lead toward correct results. We are, of course, not concerned here with the superstition that physi-

ognomic and cranial structure is related to character. No evidence for such relations has ever been discovered. Our interest lies in the fact that we are often led to make character reports on the basis of past contexts in which physiognomy has been a feature.

BRIEF PERSONAL INTERVIEWS

Brief interviews are often used to afford signs for character diagnosis. We do not here refer to technical interviews in which the candidate's special knowledge and skill may be tried out. Interviews are often used as a possible means of identifying the candidate's "general suitability" for some particular activity, such as teaching, selling, preaching. Here again the typical feature of social perception is involved. The candidate "resembles" some acquaintance or other personage who had definitely known traits. This partial identity evokes the response appropriate thereto, only it is unfortunately hung about the neck of the present candidate instead. Such an "error" in character appraisal is, therefore, like the "redintegrated fear" of the neurotic soldier, the conditioned salivary reflex, the synæsthesia.

Here also definite experiments have been made. On one occasion twelve sales managers interviewed fifty-seven applicants, and rated each for suitability. The candidates were ranked in order for value by each interviewer. Except in one or two striking cases any candidate was given ranks ranging all the way from first place down to fifty-seventh place in the scale of value. They were placed by the judges, after an interview of several minutes in each case, precisely or nearly as they would have been if distributed by chance. Such disparity shows that larger sections of conduct (more details) are required than the brief interview affords, if consistent reports are to be secured.

SOCIAL PERCEPTION THROUGH ACQUAINTANCE

The use of letters of recommendation and testimonials is widespread. This indicates the trust that acquaintances who

have known *some* of our behavior may be in position to give character reports with predictive value. Studies of such reports of individuals by persons who have known them for some time have also been made and reveal many variables. When the verdicts or evaluations of such judges are compared, it is found that on some traits they agree closely; on others only fairly well; while on other traits there is great disagreement.

Traits on which such judges agree closely may be conveniently called objective. They are represented by such names as quickness, originality, energy, perseverance, efficiency. Traits on which judges agree only fairly well may be called ambiguous. They are such as balance, intensity, reasonableness, refinement, independence. Traits on which agreement is slight may be called subjective. They are indicated by such terms as selfishness, courage, integrity, coöperativeness, kindliness, cheerfulness.

The basis for these differences in the verdicts of social perception is obvious. The objective traits are manifested on many occasions, in much the same way in all, and are likely to result in objective products, such as inventions, books, biographies, salaries, and the like. But the subjective traits appear rarely (as courage), or vary with the other individuals concerned (as coöperativeness, cheerfulness), or do not leave manifest monuments behind (integrity, unselfishness).

That is to say, the objective traits afford "more data." There are more cues to coöperate in the instigation of a report, and we have often seen how the promptness, correctness, and completeness of a consequent vary with the completeness of its stimulus. This perceptual explanation is also supported by studies of the way in which degree and mode of acquaintance affect such reports. Thus teachers judging other teachers agree closely on efficiency, energy, and leadership, but disagree widely on coöperativeness, cheerfulness, and kindliness. But students judging teachers quite reverse this order of relative agreement. It is clear that in both cases the judges agree best on the terms for which their mode of acquain-

tance affords the greatest amount of relevant data. The verdicts of perception are again seen to vary with the completeness of their cues.

PERCEIVING OUR OWN CHARACTER

Numerous similar illustrations of the fundamental laws of perception appear in trying to estimate our own traits. Here we are handicapped by the necessity of comparing ourselves with others. However fully we may know the signs of our own character, we know less about the traits of others. Lack of adequate comparative data thus results in error, and there are also positive sources of bias.

Experiments here have compared self-ratings in traits with the consensus of estimates given by others who know the individual well. Various definite tendencies are found. The individual knows himself no better than others know him. At least in locating himself on a scale for a given trait he misplaces himself as far from the consensus estimate as other individuals misplace him on the average. In this respect, however, individuals vary considerably.

One tends also to overestimate himself in desirable traits and to underestimate his undesirabilities. The amount of this bias varies considerably with the individual, with the trait, and with its degree of prestige. We place ourselves "nearer the ideal than the typical." Further, if we define a trait as a desirable attitude, the accuracy of one who judges either himself or others varies directly with the degree of his own possession of the trait in question.

CHECKS ON SOCIAL PERCEPTION

There are various other sources of error in those acts of social perception in which we seek to identify or describe human traits. Thus there is a general central tendency of judgment, which tends to deflect all such estimates toward the type or average of a familiar group. This we shall encounter in detail in the chapter on Memory. Then there is the

"standoutishness" of individuals, which deflects all estimates of particular traits toward the general estimate of the personality as a whole. There is also a tendency for the strong impression of one trait to bias the estimates of all others in its direction.

There are sources of error in the understanding and use of trait terms. There are the ordinary variabilities both of the judges and of those judged. There is the important fact that many traits belong, not to an individual, but to a pair, or to some larger social group. Thus *A* may coöperate with *B* but not with *C*. The "coöperativeness" is not a trait of *A* but of *AB* or of *AC*. It is a feature of a configuration rather than of an element. Many of our attitudes toward others are themselves provoked by those others.

It is not in place here to consider the devious ways in which more reliable and objective methods of discovering character and aptitude have been sought. This movement has a long history and many of the activities of applied psychology lie in this field. We may, however, call attention to one feature which the various devices, in the way of tests, scales, rating charts, mental measures, psychographs, and so on, have in common.

They seek to make social perception more reliable and valid by affording it either more complete cues or cues which should have superior potency because of their greater relevance and verified significance. They thus seek to substitute coöperative and socially reported antecedents for the variable contexts of individual history. Elaborate investigations and their reports are substituted for personal impressions. This is what is meant by the substitution of objective for subjective methods of social evaluation and mental diagnosis. The practical results of this endeavor have been remarkable. For our purpose the topic serves chiefly as a concrete illustration of some of the systematic features of perception. Especially also it illustrates the way in which a world of "ideal construction," a socially reported or objective world, comes in time to supplant the individual and discrepant contexts of personal biography.

THE WORLD AS A SOCIAL PRODUCT

This process of pooling results into a joint report is of great significance in human life. It is a coöperative or social enterprise. Through the use of such symbolism as speech, writing, and other forms of language, we live a vicarious experience. Once having acquired our vocabularies, we proceed to substitute, for the fragmentary world of occurrences, what has been called "a world of ideal construction." This is, therefore, an inferred world, a world of construct and hypothesis.

An arctic explorer writes the story of his adventures. We read his pages, confronting there symbols drawn from past contexts common to all our lives and embodied in dictionaries. In an incomplete way, because of the extreme partiality of verbal cues, we "go with him" on his journey. We "accept" the objects he describes, often objects whose pattern is novel, but whose elements are, in part at least, familiar. Thus these regions, their flora and fauna, which we never encounter ourselves, come to be, nevertheless, an effective, inferred part of our world.

The novelist or dramatist similarly presents verbal arrays, old elements in new patterns. We accept these as "descriptions of his characters," as words have formerly applied to immediate persons. These "characters" also become part of our inferred world. Hamlet and Mephistopheles take up their abode in the realm of ideal construction.

A neighbor reports his aches and pains, his private images, feelings, and synæsthesias. Here again events are reported to us that are never encountered by us. But we react adequately to the neighbor's verbal descriptions, since these also apply approximately to pains and feelings such as do occur in nature in ways open to our own report. The neighbor's "subjective events" are, therefore, also incorporated in our world of ideal construction, along with the arctic circle, the Eskimos, Hamlet, and Mephistopheles.

In a similar way, although my neighbor and I usually report consistently the presence or absence of the rainbow,

this does not always happen. Sometimes he reports it when I fail to find it. Consistency of report at once comes to be something more than identity of report. Reports are consistent now when they are both articulable in or to the world of social construction.

In my prison cell I have no direct evidence that "somewhere the sun is shining." But the warden reports this occurrence, and I "accept his words." To accept words is in some sense to react to them as surrogates for other events. Even a prisoner in a dungeon may thus "know" events that are not at the moment accessible to him. The word "event" thus acquires an extended application. It means occurrences reported by others as well as by myself, the signified as well as the significant. Social report is substituted for individual report. The "gaps" of personal history are filled in by the testimony of competent witnesses. All this occurs through the technique of perception; it is itself a social aspect of perception.

THE REALM OF IDEAL CONSTRUCTION

This is the justification and in part the basis of inference. The process is by no means limited to social testimony, to the reports of other human beings. For

> To him who in the love of Nature holds
> Communion with her visible forms, she speaks
> A various language.

Any object or event in nature may be an idea, that is, a sign of more elaborate complexities. The concept of the "continued existence" of objects, in a sense other than that of their natural occurrence, also arises in such fashion.

I may "hold the thought" of the sun even when that event which I call its occurrence ceases. While thus "holding the thought" the sun "again appears" from behind a cloud. And other events, aside from human report, occur "as if" the sun were still "in view." One event "occurring" thus becomes the sign of another event "inferred." The appearance of my keyring every time I explore my pocket "satisfies me" that

is has *been* there throughout. Even without such explorations, the hole eventually worn in the garment is "accepted" as such a sign. Thus natural events "demand" inferred occurrences as their "meaning."

The realm of "ideal constructs," the world of "inferred objects," therefore, includes not only the polar regions, the personages of fiction, the aches and pains of my neighbor. It includes also the "permanently existing objects" and such convenient abstractions as absolute space, time, and energy. All this arises through the substitution of social for individual report. This occurs on the redintegrative basis of perception, through reaction to cues in ways appropriate to more elaborate complexities.

We need note only one further point, namely, that this social world of ideal construction is a subsequent or product of perception, not the basis of it. It is in the world of ideal construction, not in the continuum of nature, that such puzzling distinctions arise as those between mind and matter, mechanical and vitalistic, energy and consciousness. It is in this world that spirits and demons reign and depart; that phlogiston, ether, and ectoplasm are invented and discarded. Psychology also develops such constructs and conjectures. In this inferred realm belong such capitalized powers as the Will, Memory, Purpose and Intelligence, and such "permanent entities" as instincts, complexes, and suppressed wishes. The world of social construction thus exceeds the reportable events of nature. It includes realms of conjecture, of varying degrees of substantiation and temporary usefulness.

CHAPTER XII

THE PSYCHOLOGY OF LEARNING

THE LEARNING PROCESS

We mean by learning those activities or conditions whereby a cue acquires instigative potency. Learning is typically a redintegrative phenomenon; it is the process in which a detail becomes effective in place of the antecedent context of which it has been a constituent but partial feature. The essential fact in learning may, therefore, be described as the reduction of the stimulus leading to a response.

The more complete the learning, the further does the reduction of the stimulus proceed. In time the requisite stimulus may be so slight or subtle a cue or detail that its precise identification may be difficult. This is especially true, in as much as *various* reduced stimuli may become effective, now one and now another being involved in the production of a given response. Moreover, in some cases the effectiveness of a given predetermined cue may be set as the goal or criterion of learning. Before this point of reduction is reached, then, progress in learning may be shown by the increasing frequency, ease, or certainty with which the predetermined cue operates.

Since the study of learning is thus the investigation of certain special aspects or conditions of redintegrative sequences, it is clear that throughout our previous chapters we have been referring to acts of learning. The neurotic soldier feared sudden sounds, sharp weapons, and the uniforms of officers, because he had learned to do so. That a single episode on the battlefield should suffice to establish the instigative potency of such details makes this a rather spectacular case. Unfortunately for our leisure, most learning

is more tedious and time-consuming than this, since ordinary situations lack the vividness of battle contexts, and must be oft repeated.

A more familiar sort of learning is that illustrated by the "conditioning" of the salivary and pupillary reflexes, the training of the terrier to obey verbal commands, the slow acquisition of the understanding and use of language by the child, and the long process whereby spatial cues become effective. On the one hand, we have seen in these cases that many repetitions of a type of sequence are often required for the redintegrative potency of the details to become established. On the other hand, we have clearly seen, as in reading and in space perception, how weaker, subtler, and sometimes concurrent or artificially introduced details do in time become effective cues for a given consequent.

A more detailed study of learning therefore introduces no new phenomena. It consists, instead, of a more careful analysis, and, where possible, a quantitative description, of the conditions of redintegrative instigation. We begin with special consequents and inquire into the way in which the reduction of the effective antecedents proceeds. Learning may be defined briefly as the mastery of something once done. But brevity of definition should not be used to conceal the actual complexity of many learning processes.

LEARNING A CODE

We may begin with an illustration in which the cues, in the beginning, are chiefly visual, the familiar process of learning to substitute one symbol for another according to a given code. In the following section of a test sheet used for such experiments a code key is given at the top of the sheet. To each of an array of geometrical forms a particular number is assigned, and the learner is required, in the following empty forms, to put in each in turn the proper digit as shown in the key.

Since all learning proceeds on the basis of activities already established, we may begin with the case in which the learner

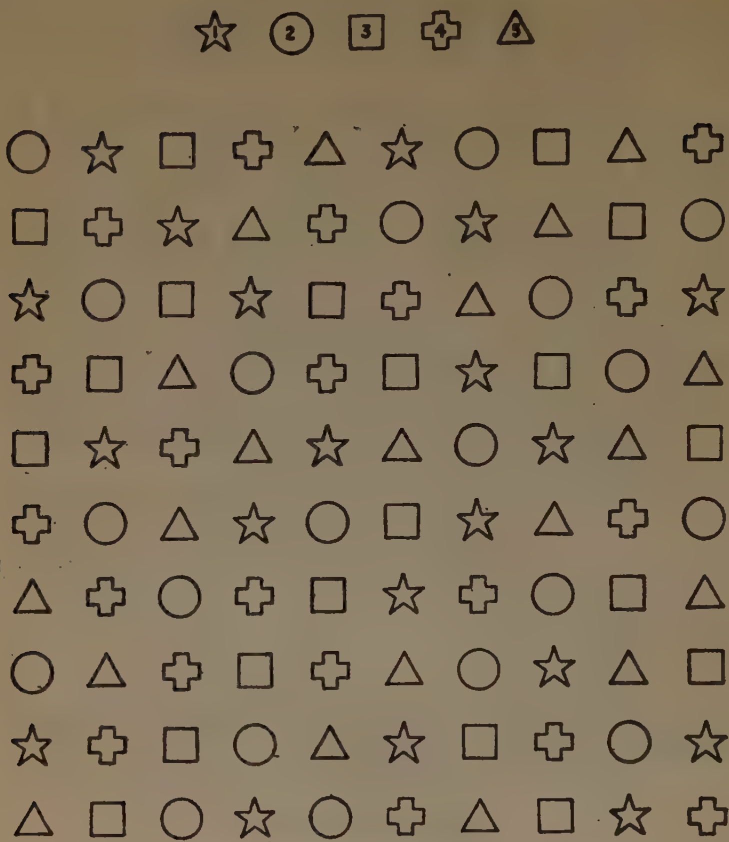

Fig. 19.—Substitution sheet.

has previously acquired the art of speaking a number which is seen and of writing the numbers which he speaks. When he sees a 3 in a given form he can, under instruction to do so, himself duplicate what he sees by saying to himself "three" and by writing 3 in a similar but empty form. The nature of "instructions" or "directions" will be considered in a later chapter dealing with purpose and intention.

The learner, therefore, begins, putting in each form the number which the code prescribes. In the beginning he refers

to the key at the top of the page as often as he likes. As the work proceeds he finds less and less need for such reference, and by the time the end of the page is reached the average human being has "mastered" the code, that is, needs no longer to refer to the key. Now it is clear that there are infinite variations of such a code. The number and complexity of elements, the number and distribution of trials, the speed demanded, and so on, will all influence the quantitative aspects of the results. But the process of learning is likely to be much the same in all these various cases.

The process is something like the following. Seeing an empty $\square$ on the page, and in the code key above a similar $\square$ containing the number 3, thus $\boxed{3}$ the learner begins to work. Under the instructions to duplicate what is seen in the key, he probably says "square, three," and meanwhile writes a 3 in the first empty square. Then he proceeds to the next empty form. When the square next occurs he must again look at the key, and so also perhaps for several subsequent squares. Shortly when a $\square$ appears he finds himself saying "three" at once, starts to write 3 in this form; looking quickly at the key he is reassured and continues writing the 3 as he had already begun to do. Soon the mere appearance of a square leads to saying "three" and to the writing of 3 in the empty form. Then the speaking of "three," already done in a whisper, lapses into "silent speech." But there may still come with the appearance of the $\square$ the visual image of a 3, which might also have been present in each of the foregoing trials as well. Finally even this visual image drops away or comes so slowly that the writing of 3 in the next empty square runs ahead of it. The translation of a square into a number, according to the code, is now "automatic." And in the case of each of the other forms the process of mastery is similar. The mere visual appearance of the form leads to the writing therein of the proper number. Inspection, vocalization, and visual image drop out, or at least inspection does. Vocalization and imagery play a double rôle: they are

both responses to the visual inspection, and stimuli to the act of writing. As response to the visual form, they may continue to appear, but lag behind the writing act. Although formerly necessary stimuli to this act, they now cease to be required for it, although they are each still capable of acting as such stimuli and may be used in moments of difficulty.

Briefly then, the response concerned being "writing 3 in the □ according to the code," the initial stimulus or antecedent to this consequent is complex. It includes, analyzed according to the mental or redintegrative paradigm, the following pattern:

Antecedent	Consequent
The verbal instructions The sight of a square form The appearance, in the key, of a square containing 3 The whispered "three" The visually imaged 3 The kinæsthesis of preceding movements	Writing a 3 in an empty square

At the end of the learning process a single one of these constituent details of the antecedent, as the sight of an empty square, instigates the response or consequent formerly following the total context. When this reduction has occurred for all the forms, the code is learned, and translation is freed from the key, which is no longer referred to. A further stage of reduction, in which kinæsthesis is involved, will be considered in connection with rote learning in a later section of this chapter. Quantitative results of the study of code learning will be given in the following chapter, along with an account of other quantitative studies of learning.

Before leaving the analysis of code learning, it should be noted that even so simple an act as this involves "investigation" or "problem solving." If we merely placed the sheet

before the subject with no "remarks," he would not "know what to do." He would look at us inquiringly, and this would be investigation. Even when we give him the verbal instructions, he does not yet "know what to do," in any specific way. He has to "refer to the key," and this is investigation. In the middle of the sheet he need only note the vocalization cues which arise with each empty form (the silently spoken numbers), or the visually imaged numbers. But this noting is investigation. At the end the only requisite cue is the seen form. But even this may be called investigation, in as much as the observation includes more than may be needed at a later stage of learning. In such a final stage a mere portion of the forms, such as ∠, ᑕ, or ∟ would suffice to evoke the numbers appropriate to triangles, circles, and squares. Ultimately indeed even these cues might drop out or be no longer needed. The mere numbers, in their correct order, might be "known by heart," without any reference whatever to the printed sheet. In order to exhibit still more clearly the nature of learning, we may profitably observe somewhat closely this very late stage, namely, learning "by heart," or rote learning.

ANALYSIS OF ROTE LEARNING

"Learning by heart," though an old and misleading term, is a very suggestive one. For the heart is a muscle, and learning by heart is essentially learning to respond to kinæsthetic, that is, to muscular cues. Or, more generally, the heart is an internal organ, and learning by heart is the establishment of instigative effectiveness on the part of cues originating within the organism. Just what these vague statements mean may be clarified by considering that late stage of code learning in which the numbers belonging to a set page of forms may be recited correctly and in proper order without any visual reference either to the key or to the page of printed forms or to such visual imagery as might be aroused by such stimuli.

When the learner reaches a point where a portion only of

the visual form is required to instigate the appropriate written responses, the effective antecedent is still, as a matter of fact, complex. For part of the antecedent to writing a given number is also the "feel" of the movement patterns concerned in the writing of the immediately preceding numbers, and those just before it. Each writing as it occurs involves not only its visual and graphic features, but also its kinæsthetic "feel." The immediate antecedent of a given writing act, at this late stage of learning, thus includes the following:

(*a*) The visual appearance of all or part of the next empty form, say a circle.

(*b*) The vivid kinæsthetic features of writing the number in the immediately foregoing form, say 1 in a triangle.

(*c*) The gradually waning but in some sense cumulative residuals of the writing of the somewhat earlier but not immediately foregoing numbers, thus 2 in a square, 4 in a cross.

Now in the further course of repeatedly filling in the empty forms on such a set page, it comes to pass that all visual cues come in time to be superfluous. The kinæsthetic patterns of previous motor acts become effective stimuli in instigating the next act in the series. The feel of one movement or of a given stage in a movement series suffices to evoke the next movement. In any thoroughly skilled or automatized act in which definitely ordered movements thus succeed one another this is usually what "perfect learning" means.

Learning by heart is thus the redintegrative effectiveness of subtle kinæsthetic or other organic clues as they function for very elaborate antecedent complexities. Such skills as reciting a list of nonsense syllables, speaking a piece, singing a familiar song, writing an oft-practiced sentence on the typewriter, walking, bathing, swimming, dressing, illustrate such perfected accomplishments. Investigation, that is, complexity of antecedent context, is present in diminishing degree, up to the very last stages of apparent "mechanization." The reason that former clues appear to "drop out" is simply that the response is provoked before these cues have time to occur; such a response often actually mechanically interferes with

their occurrence, as we shall see in connection with learning to play the piano.

LEARNING TO WALK

A few further examples will be useful in emphasizing this typical redintegrative procedure in learning. Thus in an early stage of walking the learner requires a great many cues for the adequate balance and coördination involved in effective and safe locomotion: the vision of near-by objects; organic and static (vestibular) patterns of stimulation that vary with general bodily position; the tactile feel of the feet on the floor; the kinæsthetic patterns involved in movements of legs, arms, trunk, and eyes; and the spatial effectiveness of a great many cues.

Learning to walk proceeds in so far as the simultaneous presence of all these co-stimuli may be dispensed with. At first walking in the dark does not well succeed, because at this stage visual clues are still needed. Later, kinæsthetic and static cues alone are needed, and the process may become so easily instigated and guided that the individual, in time, can "walk in his sleep." If later in life, injury or disease (as in locomotor ataxia) should deprive the individual of kinæsthetic cues, walking can still occur if other cues are available, such as the visual appearance and the spatial features of the surroundings.

Of course learning to walk is also conditioned by purely physical factors, such as body weight, and the growth of the bones and muscles and the nervous system. But learning is so important a factor that there is a definite and positive correlation between age of walking and the learning ability of the individual in later life, as manifested in other acts of acquisition. Learning to walk is not, however, so prognostic an index as is learning to talk.

LEARNING TO RECITE VERBAL SERIES

In learning a list of printed words, numbers, or nonsense syllables, so as to be able to repeat the material verbatim in

speech or writing, the learner must first have acquired the skill to make specific vocal or graphic patterns upon the sight of particular visual patterns; that is, in the case of oral recitation, the learner must already know how to speak words which are seen. This is itself a complex act, as we have seen in the chapter on language. On the basis of such preliminary skill, learning may now proceed further.

Looking at the printed words in turn, he speaks them one after the other. In the first reading the words do not *lead to* each other. But during this reading the precise articulation of each word, except the first, is a co-response to at least two co-stimuli. These are: (*a*) the sight of the printed word, and (*b*) the kinæsthesis of the speaking of the preceding word. In time these kinæsthetic patterns alone lead serially into one another, or each into its successor. When this occurs the series is mastered, memorized, learned by heart or by rote.

In such a process it is also possible for imagery to play a rôle. Thus the cue to the speaking of a word may be the auditory image aroused by the sight of the word as printed. And in "recitation" the *first* word of the series, for which no reduced cue was established, must in some way be *given*. This may occur by seeing it, hearing some one speak it, or "accidentally" saying it one's self as a part of some other situation.

It is a very interesting fact, also, that such a series or serial performance will only run itself off in the direction in which it has been learned. No one, having learned the alphabet, or a song, poem, or dance, can *reverse* the order, except by learning this as a new feat. With respect to one another, that is to say, antecedents remain antecedents and consequents remain consequents. Of course the consequent of one sequence is commonly the antecedent of the next sequence. Classical psychology referred to this fact as "the law of forward association." But it also taught that "reverse" association was also established, though less firmly than forward association. In the chapter on quantitative studies of learning we shall see good reason for rejecting reverse association as probably resulting only from the unintentional learning, in the reverse

of the intended order, of such materials as are provided the learner.

LEARNING TO PLAY MUSIC

The learning by heart of a piano composition may be described in the same fashion. We may, for brevity's sake only, assume that the pupil has already learned such things as:

(*a*) To balance himself on the piano stool.
(*b*) To strike with the fingers particular visual objects in different locations (piano keys).
(*c*) To call each of these keys by name (as A, B, C, D, etc.).
(*d*) To call by the same names the printed musical notes that appear on the musical staff, in the music sheet.
(*e*) To act, in terms of movement, various other elements of musical notation, such as those denoting half note, fortissimo, allegro, and so on.

The learning of all these would have occurred according to the pattern of the typical mental paradigm, and they would enable the pupil to pick out the keys according to the notes of the music sheet and in this painful way to "play the piece." But he could, at this point, not play the piece in the dark, nor with closed eyes. At this point our analysis of his further learning begins.

The pupil's "trouble" is that the production of a given note requires so complex an antecedent context that the flow of tones is much retarded and the "melody" pattern thus impaired. To produce a given tone at this stage of learning involves, as co-stimuli, the following features:

(*a*) Having the kinæsthesis involved in the production of the just preceding tone or tones.
(*b*) Hearing the tone just produced, or an aftersensation or image of it (memory image).
(*c*) Looking at the musical staff and vocally naming a given note as, for example, "F sharp."
(*d*) Looking at the keyboard and visually fixing the key whose name is also F sharp.
(*e*) Striking this key with the specific finger with which it is to be struck, either according to previous learning or according to the fingering numbers placed above or below the notes in the music sheet.

As skill develops, these stimuli one after another become, each of them, potent to evoke the consequent originally based on or requiring them all. The *sight* of the note on the staff in time leads directly to appropriate movements. The *name* of the note will also do so, as will even the appearance of the *finger number* alone. The performer now "plays at sight."

In time all these visual cues may be dispensed with, for the auditory cue, the sound of the *preceding* tone, is adequate, and the composition may now be played in the dark, that is "played by ear." Or, even if the player's ears be padded, he may "play his piece" in the dark, "by touch and kinæsthesis." When any or all of these cues are as effective as the original complex context of co-stimuli was, learning is "accomplished." Throughout the process, learning has consisted in the fact that partial features gradually come to act as effective surrogates for the initial complexity of which they once were parts. This is why learning is a *mental* process.

Of course, as we have intimated in connection with walking, there are other than psychological factors that are likely to be involved in the course of any prolonged learning process. In coming to be a "good walker" the child is much facilitated by the physical growth of bones and muscles, and by increase of strength due to exercise and food. So also in becoming an expert pianist or typist, the individual's progress is facilitated by the strengthening of muscles in back, eyes, wrist, and fingers; by the growth of fingers and arms in length with increasing age; by the increased flexibility and nimbleness of the hands through exercises; by maturing discrimination and acuity for pitch and intensity of tone; by increasing familiarity and delicacy of kinæsthetic patterns; by emotional episodes which change the general tonus of the bodily apparatus; by modifications of interest and incentive.

So also the process of learning may be impaired by bodily illness, by sensory deprivation, by fatigue, by intoxication, by distracting concurrent stimuli. Some of these influences, favorable and unfavorable, are in themselves of a mental or redintegrative nature, but most of them are more definitely nonredintegrative, that is physical or physiological. Their

discussion in psychology is, therefore, only incidental to the account of the *conditions* under which mental sequences run their course.

LEARNING AS PROBLEM SOLUTION

In the illustrations of learning we have considered up to this point we have been concerned chiefly with somewhat late stages in the total course of the process. The result of learning was easy to state, namely, the production of a specified consequent or outcome by stimuli of gradually increasing subtlety. The general trend or course of activity was usually communicable to the actor through language, in the form of "instructions." The urgency of the occasions was not great, and the elementary processes involved were usually already well established items of the individual's repertoire. Moreover, the region of preliminary *investigation* was artificially and wittingly limited. Thus the piano student need only look at the music sheet, at his fingers, and at the keyboard. The code translator need only look at the key at the top of the printed page of forms.

That is to say, the context needed for the *early performance* of the consequent or desired response was narrowly limited by the design of the experimenter and in terms of the subject's previous career and activities, his known previous learning. The first performance is thus relatively easy, and learning consists in the subsequent changes in its facility and ease of instigation. Nevertheless, we emphasize the fact that even the code learner, in order to *solve his problem* the first time, did have to investigate. He had, at least, to listen to the experimenter's instructions and look at the key at the top of the page. This set of antecedents, complex enough, as we saw, and yet relatively simple, sufficed, in the light of his past training with letters, numbers, writing, verbal commands, to "show him what to do," that is, to instigate the consequent the very first time, in the light of *more* complex earlier contexts.

Special interest, and much confusion also, have developed in the psychology of learning, in connection with situations in

which the first accomplishment requires a relatively large field and a relatively prolonged period of *investigation.* Such situations are illustrated by a hungry animal which secures food by escaping from a specially constructed cage by moving a particular catch, determined upon by the experimenter. We may profitably use such a case for our further analysis of problem solving learning.

Such analyses in the past have not been wholly successful, because of various biases of many investigators and reporters. The experimenter has had to construct the cage and to give much thought to the mechanics of the catch, in order that it may be manipulable by the animal chosen. He has had repeatedly to prepare the food and to place it in a carefully described position. He is required carefully to observe what occurs, to record it objectively, perhaps, or to time it. He must arrange the conditions and conduct his observations with pain and precision, so as to escape the criticism and possible ridicule of his fellow scientists.

Since he has taken so much pains in preparing the food and in locating it, and does not begin his records until the food is produced and in place, the food object looms large in his mind. He calls it the stimulus. Since his observations, often tedious and exacting, will end when the animal secures the food, this is the thing desired, the motive. And since he has to describe as much as he can of what goes on between these two moments, he thinks of the animal as struggling to get the food. Each act of the animal is thought of as being a "response" to the food, or at most to the situation of being hungry in the cage and seeing or smelling the food.

Acts which do not shortly secure the food are called "false responses." An act which liberates the animal and thus terminates the experiment is called a "correct response." Many of these "useless" acts drop out, as the animal learns to escape to the food by properly moving the catch. The puzzling problem then arises: How are the *false responses* eliminated and the *correct response* selected?

On this problem students of learning have debated, sometimes heatedly and often with bitterness, for at least a half

century. How does it happen that the "successful act" is "stamped in," and subsequently comes sooner and sooner in the process? And how are the "unsuccessful acts" discarded, "stamped out," inhibited, or obliterated? At present the debate is chiefly over two points. First, how far are the early and "useless" acts to be described as "random movements"? Second, is it possible, and if so, how can it happen, that "success," "effect," "satisfaction," produced by the final act makes this act more likely to occur or likely to occur earlier in subsequent experiments?

Without unreservedly disputing the interest of such questions, the redintegrative account of learning has its own suggestions to offer. Thus it insists that the learning involved in earlier trials follows the same mental pattern as that of later trials. The initial acts of "discovery" proceed as do the later acts of more perfected accomplishment. Now in these latter cases the *consequent* was taken to be the final result—a note sounded, a number placed in a form, a step safely taken, a verbal series recited, and so on. Foregoing events, such as looking at the code key, inspecting the keyboard, were not *responses*. Instead, they were members of a group of *co-stimuli*, part features of an antecedent complexity.

To be sure, such features did not all occur simultaneously. The piano student first looks at the printed music, then names the note, thereupon looks at the keyboard, next identifies the key so named, and finally strikes the key. The events preceding the striking were not *responses;* instead they were, from the point of view of piano playing at least, *co-stimuli*, a serially patterned antecedent context. Perfect learning consisted in some of these items becoming potent to instigate the response formerly consequent upon the whole series. And the most complete learning is that particularly in which items become thus potent which are *always available*, namely, the kinæsthetic features of the production of preceding notes.

Suppose we similarly describe the learning of the lower animal. The so-called "random movements" are random only to the human observer, ignorant of the animal's previous learning. These movements have their own history in the

learning of the animal, and each occurs in the light of the complexities of the situation—the sight of food, the parts of the cage, the hunger pangs, the movements just completed, and the condition of captivity. All these conspire in the production of the next activity. So on, in a serial and cumulative way until in time a consequent results which (as it happens) opens the door and produces the final consequent. This, for the animal, is release and removal of hunger pangs.

It is, therefore, not the animal that acts at random. Instead it was the experimenter who built his cage at random. Had he known the set of typical activities which the animal (in the light of its past) would exhibit when hungry in a cage and confronted by food, he might build a cage from which the average animal of the species would escape quickly, and might thus expedite his observations. Such a cage might of course not fit equally well the native and acquired repertoire of animals of other species, or of the same species. But this would not necessarily indicate the learning capacity of the respective animals. It might only show how well the "randomly built" cage fitted into the repertoires of these animals. Nor is it descriptive to call the exploratory movements "unsuccessful" just because they do not *at once* result in escape. After all, they do lead to escape. In their turn, and in the animal's own way, they as co-stimuli lead to just that act which opens the cage. To call them unsuccessful acts would be scarcely more just than to call the activity of a fisherman unsuccessful merely because his preliminary digging in the garden, his trip to the attic, and his purchases at the sport-goods store failed to result in the immediate appearance of fish. That some of the animal's activities will later not be needed is, of course, true. But this is also true of the fingering instructions on the music sheet, and the verbal naming of notes on the staff by the piano student. But to call all these activities random and unsuccessful, when they so clearly facilitate progress toward a final skill, seems misleading.

The so-called random movements are like the human subject's examination of the code key and the music sheet. They are the "investigation," and as it happens they afford cues

which, as in the case of the human being, lead (in the light of past learning) to the first accomplishment. The animal's first "performance" then, as in the case of the piano student, was on the basis of an existing repertoire which, as also with the piano student, had first to be exploited.

But whereas, in the case of the human subject, the *field* of investigation was, by the instructions, limited to key code or to music sheet and keyboard, no such delimitation was provided the lower animal. The animal's situation resembled that of the college student who should be told in school by the investigator of code learning on whose desk at home lay the code key and sheet of empty forms, "There is something for which, if you do it, I will give you a thousand dollars." If this something were the completion of the substitution blank through mastery of the code, and no more "instructions" were given, we might expect even the human subject to exhibit a much longer period of investigation than he does in the ordinary code substitution test.

The animal, therefore, escapes from the cage as the consequent of a complex pattern of antecedent events. The "random activities" are *stimuli,* not *responses,* from the point of view of this consequent. (Of course, they are also responses, from the point of view of previous events.) We have then again the old problem, that of explaining how the consequent comes to follow *partial features* of this antecedent complexity. That it so does is only another appearance of our old friend, the redintegrative sequence. But why does "pulling the catch" come in time to follow directly the appearance of food, when the animal is hungry?

We might as well confess before going further that we have purposively overstated the case somewhat. Many of the activities of the animal did not in any essential way *lead up* to the final act. There were many things merely done "in passing." Just so, the code learner's final writing of a 3 in the square was also preceded by various "incidental acts." In one trial he sneezed and grinned; in another he coughed and scratched his head; in another he mechanically tapped his foot; and all through the trials he was smoking his pipe.

That is to say, the *vital* antecedent context was a certain pattern which persisted, from trial to trial, through all these incidental and variable occurrences.

So also with the lower animal. Just what the vital features of the original series were may be seen from their tendency to reappear next time, with other incidental variables. And in this vital antecedent pattern, *any* of the features tend to instigate the final act or consequent. The one that first and always occurs (hunger pang plus sight of food) will at once tend to instigate this consequent (pulling the catch). But unless the situation on the first occasion was an extremely vivid and impressive one (similar perhaps to battle collapse in the human being) the intermediate acts aroused in proper sequence by food and hunger will for some time be needed (and will occur) before the final act results.

With repetition, as in the case of the bell and the salivary reflex, language, and space cues, these intermediate acts drop out. They do so because the final act is so readily instigated by the one feature that always and first appears (hunger plus food). In just this way the intermediate acts or stimuli dropped out in the case of the piano player. The mere sight of the musical notes (plus a desire to play) leads to the striking of the right key. There is no longer any necessity for naming the note, observing the fingering directions, and identifying by name the key on the board.

Why do these intermediate stimuli drop out? Chiefly because they do not have time to occur. The proper key is already struck before they are under way, and the act of key striking even interferes with some of them. When the player is already looking ahead at the *next* note, how can he and why should he observe earlier fingering directions and scrutinize the keyboard? The intermediate stimuli do not appear, not only because they need not, but also in part because they cannot.

But if they should occur, they also, or any one of them, would be likely to lead to the proper key striking movement. For as partial features of the former complexity they still tend toward the consequent. So also with the trained animal.

If placed in the cage only when such experiments are to be performed, soon merely placing him in the cage will lead to opening the door. And many features of the original antecedent, being in no way inconsistent with the final act, continue to be performed, in what seems a sort of ritual fashion to the human observer.

Thus if a raccoon has first escaped by rolling toward a corner and standing on his head, he is likely thereafter to approach the corner, when hungry and seeking food, in the same extravagant fashion. In fact the animal may, if in the cage he becomes hungry, escape even if no food is in sight, just as organic stimuli such as kinæsthesis enable the pianist to play a piece "by heart."

What we call the motive (hunger in the usual case) is, as we shall later see in more detail, only a contributory stimulus. But it is one which because of its persistence has an enduring effect. We shall see also, in our account of motivation, that such a stimulus or antecedent operates by favoring a certain large field of consequents. It thus, in a sense, gives a certain direction to the activities from the very outset, even in the case of the animal. The problem or motive is a persistent stimulus, the satisfaction of which consists in its removal.

But the motivated or problem-solving sequences follow the redintegrative laws. Learning, as in first solutions of problems, is slow because of the great complexity of the cues which, through the animal's past learning, enable the production of the consequent. It is facilitated just in so far as this consequent comes to be instigated by more reduced or partial features of this complexity. The stimulus to an act is not merely the object which an experimenter thoughtfully provides as a starting point. It is often an elaborately complex and serial antecedent context, culminating in the act.

It is, therefore, truer to say not that in learning false responses are eliminated, but instead that initially involved stimuli come no longer to be required. The reason they are not required is that each of them tends toward the same consequent. And in special circumstances of vividness or frequency any one of them will be effective. Actually that one more

often becomes effective which first or unfailingly occurs. In animal experiments this is the hunger pang or the food which the experimenter conventionally provides.

But animal trainers know that an "educated" animal, accidentally placed in a posture which is part of its "act," will thereupon often proceed with the rest of it. And even such humble animals as microscopic forms will, when experimentally stimulated, first "hurry through" and ultimately omit intermediate acts which were formerly steps (hence partial stimuli) toward a final behavior produced by stimuli of increasing intensity. This "telescoping" of behavior is like all animal learning. But it is necessary, in order to understand the psychology of learning, to describe such intermediate acts not only as responses to the initial stimulus, but also as co-stimuli to the final consequent.

The subtlety of the instigative items that may play a rôle in learning is much greater than casual observation might suggest. Thus Clever Hans, a famous "thinking horse," could tap with his foot the answers to difficult problems in arithmetic. Careful investigation showed that he stopped stamping only when some one was in his field of view who knew the answer (the time to stop). Slight bodily movements made by such a person when the "critical point" was reached served to stop the horse on the right number. He had learned to start tapping when spoken to in a certain way and to stop upon this faint cue, almost imperceptible to human vision. Thought readers and muscle readers and some salesmen learn to react thus delicately to slight signs of interest and attention on the part of others. We shall later see that learning and intelligence are closely related. This is at least in part because both are terms for the capacity to react in specific ways to very subtle cues or symbols.

Of course, such learning cues are often, if indeed not always, relational in character. Even so generally stupid a creature as a hen learns to react to what we, at least, call "the relation between" two simple qualities. Thus hens were, when fed, always confronted with two areas of different brightness, say one of light and one of medium intensity. Their food was

always placed on the medium (hence the darker) area. In time they learned always to run to this medium area when admitted to food. Thereupon the areas were changed. The light area was eliminated and a dark one now occurred, alongside the original medium area.

It might have been supposed that, if the hens were wise, when now again admitted for feeding, they would as usual run to the medium area, where they had formerly found their food. But not so, these hens. Instead they went to the dark area, which was a new one. Apparently they had not learned to find food on a medium area, that is, an area of a given absolute brightness. Instead they had learned to go to the darker of two areas presented. This would be the medium area in the training series, but the new and dark area in the test. Of course, most human learning, also, is not connected with simple qualities but deals instead with relations, forms, configurations, and situations, of various degrees of complexity and subtlety.

REWARD AND PUNISHMENT IN LEARNING

A very old problem in connection with learning concerns the influence of pain and pleasure on such activities. What has been later called the "law of effect" belongs here. This law, as a definite formulation, dates from Bain's discussion, fifty years ago, of "Education as a Science." The following quotation from this early writer will serve to indicate the general nature of the observations.

> We assign the first place to intrinsic charm, or *pleasure in the act* itself. The law . . . of greatest potency is that Pleasure sustains the movement that brings it. The whole force of the mind at the moment goes with the pleasure-giving exercise. . . . So it is with the deepening of an impression, the confirming of a bent or bias, the associating of a couple or a sequence of acts; a coinciding burst of joy awakens the attention and thus leads to an enduring stamp on the mental frame work.
>
> [This] engraining efficiency of the pleasurable motive, [this] moderate exhilaration and cheerfulness growing out of the act of learning itself is certainly the most genial, the most effective means of cementing the unions that we desire to form in the mind.

> [And on the other hand] by the law of the will, pain repels us from the thing that causes it.[1]

A more specific formulation is that called by Thorndike the "law of effect." This is stated as follows:

> To the situation, "a modifiable connection being made between a stimulus and a response and being accompanied or followed by a *satisfying* state of affairs" man responds, other things being equal, by an increase in the strength of the connection. To a connection similar, save that an *annoying* state of affairs goes with or accompanies it, man responds, other things being equal, by a decrease in the strength of the connection.[2]

Since we have had no occasion to call upon the celebrated "law of effect" in our account of learning, it may be asked what explanation is to be given of the prominent rôle attributed to pain and pleasure in the art of teaching men and animals. Even the lower animals are trained by punishing or rewarding them for their bad and good acts, respectively. Can this practice, with its undoubted practical warrants, be justified and explained without assuming that pleasantness and unpleasantness, or their physiological correlates, work *backward* by way of "stamping in" or "stamping out" the movements which produced them or were followed by them? Do we forget the disagreeable, and if so, how does this enter into an account of learning in redintegrative terms?

There is a very ready answer, and it is astonishing how commonly it is overlooked. Pleasantness and unpleasantness, reward and punishment, do affect conduct. They do so, however, by modifying the *stimulus*, not by mystical operations on the movements. The burnt child shuns the fire, not because pain did anything to his movements, but because, since that pain, the stimulus has changed. It is no longer "flame plus curiosity"; it is now "flame plus fear."

For the present stimulus is not merely the flame, which may

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[1] Alexander Bain, "Education as a Science," *Mind,* Vol. II, (January, 1877), p. 5.

[2] E. L. Thorndike, *Educational Psychology: Briefer Course* (Teachers' College, 1914), p. 71.

be, for the fireman, an abstract and isolated object. The present stimulus is the total situation of the moment, the complete antecedent of present behavior. This includes the seen flame, plus the imaged pain, plus the fearful emotion redintegrated by the flame on the basis of the previous context. The "avoiding reactions" are not merely to the flame but to this total situation. Once the stimulus was visual pattern, plus interest; now it is visual pattern, plus imaged pain pattern, plus emotional tone of strong fear.

Since it is a different stimulus, there is little wonder that it produces a changed response. Nor is it remarkable that the principle element, the avoiding reaction, is the same for pain and for fear. Nothing has been "stamped in." Nor has unpleasantness worked retroactively so as to "stamp out" or eliminate movements. A lion quietly feeding in his cage produces one type of response in the spectator. The same lion, roaring, with eyes rolling and lashing tail, at large in a city square, is no longer "the same lion." At least the stimulus to action, it is clear, includes more than the lion as a colored visual pattern. Here, too, then, something has been added to the stimulus; the stimulus has changed.

Neurotic soldiers, before the armistice thrown into paralysis, tremor, or stammering by the sight of an army officer, were found after that event to encounter such officers with astonishing poise and balance. Shall we say that the armistice worked retroactively upon the soldier's movements or neurones, stamping in or stamping out, as the case may be? Instead we need only to note that the occurrence of the armistice changed the perceptual character of such stimuli as army officers in uniform. The officer was now no longer "he who has power to send me back to fight," but "he whose job is to sign my discharge papers." Little wonder that such different stimuli led to different responses.

Just so, the *law of effect* is valid enough as a rough principle of human engineering or as a crude pedagogical rule. To inhibit an act, add unpleasantness to the situation; to encourage it, add pleasantness. And apply these affective features as soon as possible; not, as the advocates of the law of

effect usually assert, to get it close to the response; instead, in order to get it close to the stimulus, so as to become part of it. If you apply it sufficiently close to the stimulus, so as to make it an intrinsic part of the antecedent, the response may even be prevented or guaranteed before hand. But when this engineering rule of thumb is used as an explanatory principle as well, it is little wonder that it lands its advocates either in mysticism or in fantastic physiological fictions.

THE PROBLEM OF TRANSFER

Especially in connection with educational philosophy the question has arisen: Does what is learned in one situation transfer to other situations? And if so, in just what sense or in just what way can learning be generalized? Is it through the discipline and strengthening of powers which may be generally employed, or is the transfer in terms of more specific and particular details.

What has been learned may be used. This really solves the much-debated problem of the transfer of learning. If the sight of a square is potent to instigate the writing of 3, this acquisition may be used in any situation in which it is called for. It may, therefore, be transferred to situations of which it is an intrinsic part, and facilitate their handling. But for the same reason it will interfere with the mastery of situations in which it is required that such a stimulus lead not to 3 but to some different or even to some incompatible act. The stimulus tends to evoke the consequent which formerly followed it. If this is useful, we have transfer; if it is detrimental, we have interference.

For this reason it is often said that learning in one situation or task may be transferred to other situations, only in so far as the two situations have common elements. We should, however, qualify this statement by noting that the "common elements" must be such as were actually learned in the first situation, if transfer is to occur. The features learned in one situation have, of course, all degrees of simplicity. They may be so simple as the connection between a geometric form and

a number. Or they may be more complex, as in the use of the pencil and the manipulation of paper sheets. Or they may be very general, as in the case of perfected optical coördination, habits of work, or the tendency to use words in the place of images in thinking. In some apparently curious cases, such as those in which the training of one hand results in improved activity of the other, we may suppose that some such general features are common to the two performances, and that the transfer is not of manual elements.

Things learned in one town may thus be used elsewhere. Words learned in the reading of one book may be used in reading others. What has been learned may be used, if the occasion is such as to make its use profitable. Of course, this is very different from saying that since I have "practiced learning" in one situation my "learning ability" will be thereby improved for all other situations. For there is no "learning faculty," except in the sense that things once learned may thereafter be employed.

There is, perhaps, one further question that arises in connection with the problem of transfer of learning. Thus it may be urged that it does not follow, from the fact that what has been learned *may be* elsewhere employed, that such use of previous learning *will* actually occur. If it should occur, then transfer has been accomplished; if it does not, there is, therefore, no transfer. It may, therefore, appear that the real problem of transfer concerns the conditions under which previous learning *is* or *is not* used in new situations. Thus a feeble-minded boy who had learned to respond to the cue "Write your name" by writing "Richard," was found unable to respond adequately to the instructions "Write the word 'rich' now." Shall we say that this boy shows no transfer, is unable to use what he has previously learned?

The answer is obvious only if one notes carefully precisely what has been learned. The feeble-minded boy had learned to "write his name." And this he is now able to do under varying circumstances and when requested to do so by different instructors. But he has *not* learned to divide words into their constituent syllables and to write these separately. Why then

should he be expected to do so? That the "bright" child can do so without special academic instruction shows only that bright children acquire much learning without formal pedagogical supervision. The bright child who makes such syllabic division has either previously learned to do so, and hence is transferring what he has previously learned, or else he is now learning to do so for the first time, through original discovery perhaps, and hence no problem of transfer is involved. And it should never be forgotten that "learning" and its psychology are not limited to what goes on under the eye of a pedagogue. Probably the greater part of human learning is by way of original discovery. But original discovery involves always also the use of previous learning.

Further, learning and its cues often develop in ways that are much more specific than the practical observer may conjecture. Thus the code learner may have learned only to respond to the cue "clearly discerned visual square" by the response "writing 3 therein." It does not follow that in some more complex situation, in which "squares" are obscurely present, the writing response will be evoked. For this response has become the consequent not of "squares obscurely hidden and requiring preliminary perceptual abstraction," but of "squares clearly discerned." The failure to transfer to complex situations such learning as may have been previously acquired in simpler situations does not raise any occult problems. It only calls for precise description of the cues and consequents involved in the previous learning.

From the practical point of view concerned with the problems of effective tuition, as in school or industry, two or three suggestive principles clearly emerge, which have quite general application. In the most economical instruction precisely that thing is learned which is to be subsequently employed. Effective instruction thus requires a clear perception both of just how the final act is comprised and of the typical process of stimulus reduction by which this level is attained.

Again, the learned act should be acquired in that pattern in which it is to be subsequently used. Thus in human affairs the act of spelling words is nearly always a visual and graphic

affair. We spell words when we need to write them, not when we hear or speak them. This is, perhaps, the reason the old oral methods of spelling, as adopted in "spelling bees" and the oral recitation, have in time given way to learning spelling through writing and composition. The change is psychologically justified. Similarly, the old method of teaching reading by the spelling out of separate words was abandoned when it was learned that ordinary reading cues are so much reduced that the mere form of words, or their dominant letters or initial syllables only, come to be the stimulus in ordinary reading of familiar material.

Finally, the quantitative results recommend strongly the use of rational or meaningful methods, as contrasted with the more mechanical reliance on position, frequency, and irrelevant modes of vivid impression. Meaningful or rational learning is particularly economical since it intrinsically consists in the utilization of learning already accomplished. New items are attached to systems of knowledge or fields of interest already established.

CHAPTER XIII

QUANTITATIVE STUDIES OF LEARNING

THE NATURE OF QUANTITATIVE PROBLEMS

No field of psychological inquiry has been more diligently studied by experimental and quantitative methods than has the general topic of learning. In a sense, of course, all psychological phenomena, or at least all mental *processes*, involve learning; that is, they are redintegrative sequences. But the term "learning" is by common practice used especially for the *changes* which occur in the course of numerous repetitions of a given type of sequence. Qualitative studies of learning, such as those of the preceding chapter, are concerned chiefly with the identification of the cues and with such changes in the consequent as may occur. Quantitative studies, on the other hand, are more concerned with the temporal conditions of such processes, their time relations.

Thus such questions arise as the following, in connection with any given learning situation, such as code learning or learning to play the piano. What time interval intervenes between cue and consequent, and how does this interval vary with different circumstances? How many repetitions are required for a specified reduction of stimulus to be effected? How is this accomplishment modified by rate, distribution, and massing of different trials? How is it influenced by various intervening activities, by the type of material, by method of teaching? Does the effectiveness of a given cue, once established, change with the lapse of time? If so, what are the quantitative aspects of these changes? What individual or species differences are found in these quantitative features? How are the temporal features modified by age, distraction, physical influences, illness, drugs, and so on? What techniques

of training are most favorable for quick and permanent learning?

The questions are, indeed, almost endless in number and variety, since the variables are so various in number and in degree. We cannot hope to summarize all the findings of such quantitative studies of human or animal learning. We can hope only to give a general indication of their nature, to state some of the more firmly established and significant results. And for practical reasons it will be well to limit our account almost if not entirely to the case of human learning. In this field alone we shall have to select only the more outstanding or valuable findings. There are available studies of the acquisition of simple manual and sensorimotor dexterity and skill, such as that involved in target-hitting, eye-hand coördination, ball-tossing, and of more elaborate performances such as typewriting, telegraphing, learning foreign languages or vocabularies. There are studies of learning in such problem-solving situations as the solution of mechanical puzzles, the working of riddles, the mastery of tools and machines. There are many investigations of the mastery of verbal series, as in memorizing prose, poetry, arbitrary combinations of words and numbers, combinations of numbers, words, colors, and the like with other sorts of objects. Many experiments have been conducted on learning in highly symbolic situations, such as in learning to read, learning the fundamental processes in arithmetic, learning the content of such special fields of knowledge as history, physics, algebra. And there are many closely controlled studies of learning in test situations, as in the code-learning substitution test which we have already described. In the following sections we describe only a few such studies. Many separate volumes in the literature of experimental psychology have been devoted exclusively to the description, analysis, and measurement of the learning process.

EXPERIMENTS IN CODE LEARNING: INDIVIDUAL DIFFERENCES

In such code learning as that we described in the foregoing chapter, since writing movements are already well practiced,

the rate of translation in different parts of the sheet depends chiefly on the degree of freedom from the key. In the first line the key is constantly referred to; in the last line little or no use is made of it by the average human adult. Comparison of the times required for successive lines or sections thus affords a measure of the rate of learning, under the conditions of the experiment. Thus the difference in time required for the first half and the second half of the test sheet is a suggestive, though not a precise measure of the amount or rate of learning.

One hundred college students, when measured with the substitution code described, gave the following results:

TABLE VI

Code Learning of College Students

	Average of the Group	The Quickest Student	The Slowest Student
Time in seconds required for first half of the sheet	66	46	97
Time in seconds required for second half of the sheet	61	38	91
Number of seconds improvement in the second half of sheet....	5	8	6
Per cent improvement	7.6	17.4	6.2

The average time required for the first half is sixty-six seconds, but individuals differ greatly, the slowest requiring a little over twice as long as the quickest. The average time for the second half is sixty-one seconds, and now the slowest requires nearly three times as long as the quickest. The average gain, when second half is compared with first half, is five seconds, or 7.6 per cent of the time for the first half. But again individuals vary considerably. Thus the slowest worker gains only six seconds, or 6.2 per cent of his first-half time; whereas the quickest worker gains eight seconds, or 17.4 per cent of his first-half time.

These general results are quite commonly found in the study of human diversity in learning capacity. Individual differences are great, even when general conditions of the experiment are constant. The best worker in the beginning tends also to be the best at the end of practice. Moreover, the quickest worker in the first half gains more than does the slower worker, both in absolute time and in relative time or per cent. And the effect of practice is to make these individual differences more striking, rather than to efface them.

Such differences in the rate of learning are fundamental and deep-seated characteristics of individual organisms. An outstanding problem is that of learning on just what they depend —with what other facts, mental or physical, they are correlated. Of course, such differences may easily be given names, such as docility, intelligence, or memory. But the student should realize clearly that giving a name to facts is no explanation of them. Names for such differences are, nevertheless, necessary, for the facts thus named are of far-reaching importance in human life and affairs, as in school or industry.

AGE DIFFERENCES IN CODE LEARNING

When children of different ages are submitted to this test of substitution learning, or similar tasks, the time required for the sheet as a whole measures the speed of learning, plus slight differences in motor coördination (writing numbers). Ability as thus measured increases steadily with the age of the performer, up to about eleven or twelve years. In Figure 20 is shown the time required for the total sheet by school children of different ages. The heavy middle line gives the average. The upper dotted line shows the 25 percentile, the lower dotted line the 75 percentile. These two percentiles are the limits between which one half of the children of a given age will score. Since the variation at a given age is small, and the curve declines definitely with advancing age, this process is especially well adapted as a test or measure of individual differences.

After the period of maturity is reached, capacity for this code learning apparently declines as a function of advancing age. The upper curve in Figure 21 shows the amount done in a fixed time with this sheet by groups of men ranging from below twenty to over forty years of age. This is the curve called Substitution Learning. The other curves of the graph show

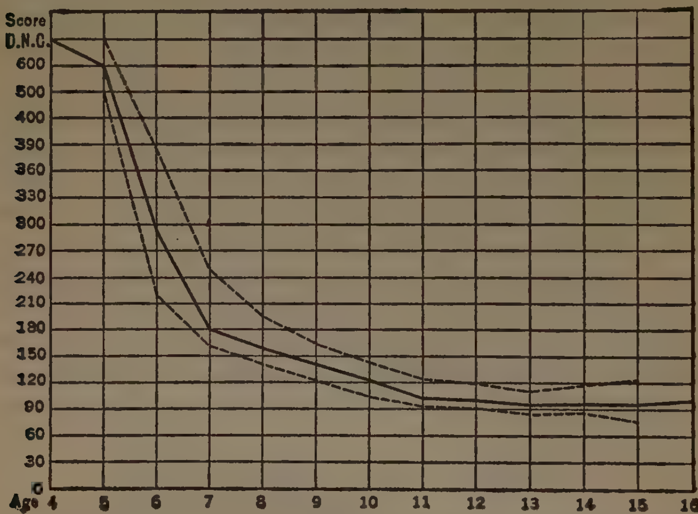

Fig. 20.—Changes in code performance with increasing age. From Pintner and Paterson, *A Scale of Performance Tests* (D. Appleton and Company, 1917), p. 134.

the performance of the same men in tasks that do not involve learning at the time, but require only the effective use of processes already acquired. The learning curve is the only one that definitely declines, and in this case (amount done in a unit of time) a declining curve means inferior capacity.

INFLUENCE OF PHYSICAL AGENCIES

The way in which such learning activities may be influenced by the effect of physical agencies is shown in the curves of Figure 22. Six men performed the code-learning task repeat-

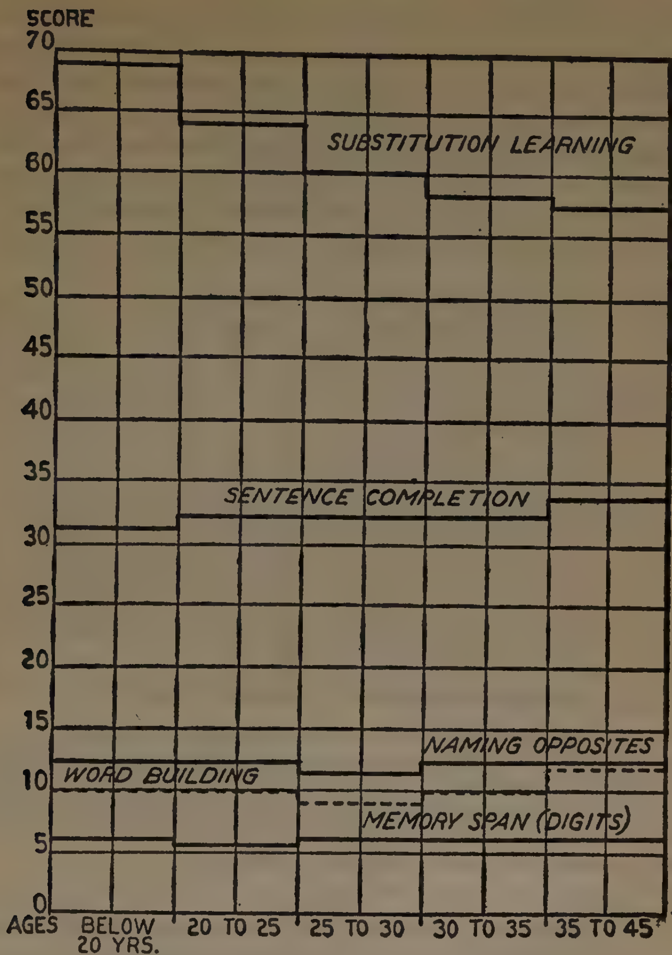

FIG. 21.—SHOWING CHANGES IN ABILITY TO DO VARIOUS KINDS OF MENTAL WORK WITH INCREASING AGE.

The higher the score the greater the efficiency, ability in Substitution Learning declines with age, while the other processes remain unchanged or slightly improved. From H. L. Hollingworth, *Mental Growth and Decline* (D. Appleton and Company, 1927), p. 313.

edly, on each occasion a different code being used. The score is the amount of work done in a fixed time. The course of the curves, across the page, represents the course of efficiency in

the code performance, during a day of work, a code test and various other tests being accomplished each half hour. In the middle of the day, at the point where the curves are interrupted, all six of the subjects (of whose work these curves are averages) were given either large doses of alcohol, in a brew, or small doses of alcohol, in a brew, or else the brew alone, as a control dose. Several days of each type were studied, and the results were combined. The heavy line represents

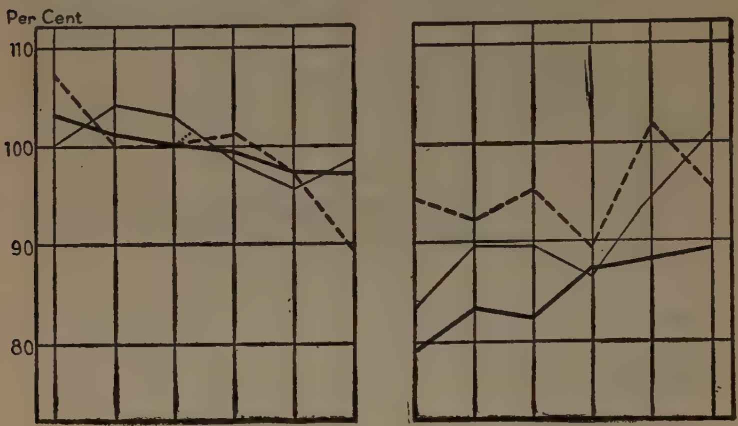

FIG. 22.—INFLUENCE OF ALCOHOL ON CODE LEARNING.

Average records. Heavy line, large doses; light line, small doses; broken line, control doses. Vertical scale represents score expressed as per cent of average forenoon performance. Horizontal line shows six forenoon and six afternoon trials, and intervening lunch period. In this test lower score means decreased proficiency.

days on which large alcohol doses were given; the light line the days for small alcohol doses; the broken line the days for control mixture.

The control curve thus shows what happens normally in the course of a day of work, with factors except alcohol dosage constant. In the first half of the day, before the dose, the curves are indistinguishable. But after the time of the dose, the alcohol curves definitely fall below the level of the control curve, indicating inferior rate of performance. With small doses the effect is definite, recovery being fairly rapid and

the normal record being approximated again before the end of the day. In the case of the larger (but moderate) doses the effect is both greater in magnitude and more persistent, and recovery is far from achieved when the experimental day ends. Such influence on the part of physical factors shows that the condition of the organism is an important element in or condition of redintegrative activity.

THE DISTRIBUTION OF TRAINING

Experiments in code learning may also be used to illustrate another problem that has been much studied with different materials and individuals. As we have seen, the reduction of the stimulus comes as the result of repetition or training in the sequence. Now, for the most economical results from the point of view of time, should the training all occur on one occasion, or should it be distributed? How does distribution or massing of training influence the learning rate?

In one experiment a group of subjects, who had already had enough practice to afford a normal basis of comparison, continued training in different ways. One group practiced sixty minutes at single sittings, another group in forty-five-minute periods, another in thirty-minute, and another in fifteen-minute periods, the total training time being the same for all groups. Improvement resulting from these various distributions of the same amount of training was then measured by comparing the final with the initial speed of performance. The fifteen-minute group gained 22 per cent; the thirty-minute group gained 36 per cent; the forty-five-minute group, 25 per cent, and the sixty-minute group, 15 per cent. Evidently the most effective period is neither the shortest nor the longest, but, in this case, the medium periods; the best period of all was the thirty-minute sitting.

This is the general result for many types of learning that have been studied. For each material, and for each type of learner (as child or adult, etc.) there is a most favorable distribution of training that may be determined only on experi-

mental grounds. Very short periods are on the whole unfavorable; they waste too much time on each occasion in merely "getting under way." And too long periods are also wasteful; monotony and fatigue may offset improvement. For each situation there is, therefore, an optimal distribution, when other things are equal. In general, the optimal period is shorter for children than for adults.

Another interesting question also arises in connection with the distribution of training. Should the periods come close together or far apart? Should they be uniformly distributed or massed in the earlier or later section of a given series of repetitions? If the process is to be just perfectly mastered two or three weeks hence, through the effect of intervening training periods, is there a most favorable manner of distributing these periods? Several experiments have been made on this point. In one of these[1] a type of code learning was studied, in which the subjects were required to substitute, for given English commodity names (as pencil, watch) prescribed Chinese trade names (as Muilap, Tailan). Three groups of subjects were used, about twenty-five in each group. The total training period covered fourteen days, and a test was also made four days later, to measure permanence of learning. Each group had nine training sittings, but these were differently distributed through the fourteen-day period. The score is the per cent of complete learning.

The trials of group A, after four trials on the first day, were uniformly distributed; they had one sitting every other day. At the end of the fourteen-day training period their average score was 48 per cent, and four days later their score had fallen to 36 per cent.

The trials of group B were massed in the *later* portion of the training period. After four trials on the first day, they had trials on days 5, 8, 9, 10, 11. On the fourteenth day their score was 52 per cent, and in the retention test four days later it had fallen to 41 per cent.

The trials of group C were massed in the *earlier* period of

[1] L. H. Tsai, "The Relation of Retention to Distribution of Learning," *Journal of Experimental Psychology*, February, 1927.

the training, more definitely. After four trials on the first day, they had training on days 2, 3, 4, 7, 11. On the fourteenth day their average score was 61 per cent, and four days later it had fallen to 45 per cent.

In general then, learning is facilitated when the training sittings come close together in the earlier part of the total period, the interval between successive trainings being gradually increased.

In another experiment the same point was investigated, using the same materials. The following table shows the methods of distributing the training sittings, and the measured results of the effectiveness of learning in each case. These results entirely confirm those of the experiment just described. All the groups had eight training sittings, differently distributed over a period of fifteen days. All the subjects were then tested three days after the last training sitting, and also seventeen days thereafter.

TABLE VII

DISTRIBUTION OF LEARNING

Distribution of Practice	Average Learning Scores in Per Cent after	
	3 Days	17 Days
Group A—One trial every other day	56.4	40.3
Group B—One trial in four days, then one in three days, then every other day for four days, then one each day for four days....	63.7	48.3
Group C—One each day for four days, then every other day for four days, then once in three, then once in four days	74.2	54.4

Here, also, it is found that uniform distribution of training throughout the period is the least effective of all the methods Massing of the training at the end of the period is better than uniform distribution. But massing of training in the earlier part of the total period, followed by successive sittings farther

and farther apart, is distinctly superior to both the other methods. Such results seem to have some relation to those discussed in a later section, concerned with the rate at which the results of learning fade away or diminish.

CURVES OF LEARNING

When a single sequence is insufficient to establish the instigative potency of a clue, this is usually to be accomplished by repetition. Such repetition, for the purpose of establishing such connections, is called practice. The gradual effect of successive repetitions, under like conditions, may be graphically represented in the form of learning curves or practice curves. The shape of such a curve varies with many features, such as the nature of the material, the individual or species, the mode of measuring accomplishment, the distribution of training, and also with qualitative characteristics of the learning process. An actual curve, secured on a given occasion, will also depend for its form on the amount of previous learning that has occurred in connection with the sequences now more effectively established.

In the following graph three learning curves for adult human beings (college students) are shown, by way of illustrating some of these features. Three activities were practiced continuously for fifteen sittings. In Color Naming, the task was to name as rapidly as possible all the color squares appearing on a sheet. There were one hundred such squares, the series being formed by the irregular and random appearance of each of five familiar colors, each coming twenty times. In Opposites Naming, a list of fifty familiar adjectives was presented on a sheet, and the subject was required as quickly as possible to go down the list, calling aloud not the word seen but the antonym, or word of opposite meaning. In successive trials the same words appeared, but always in a new order. In Calculation seventeen was to be added mentally to each of a list of fifty two-place numbers, and the answers spoken aloud. In successive trials the same numbers appeared, but always in a new order. In all cases correct responses were required

before the subject was allowed to proceed to the next item, so that the only measurable variable is the speed of performance.

The learning curves as shown are the averages of those from ten subjects and may thus be considered typical rather than actual individual curves. They show the same tendencies as do the individual curves, with the irregularities smoothed out. The curves appear at first glance to be strikingly different in form. In Color Naming there is scarcely any improvement throughout the fifteen trials. In Naming Opposites the curve

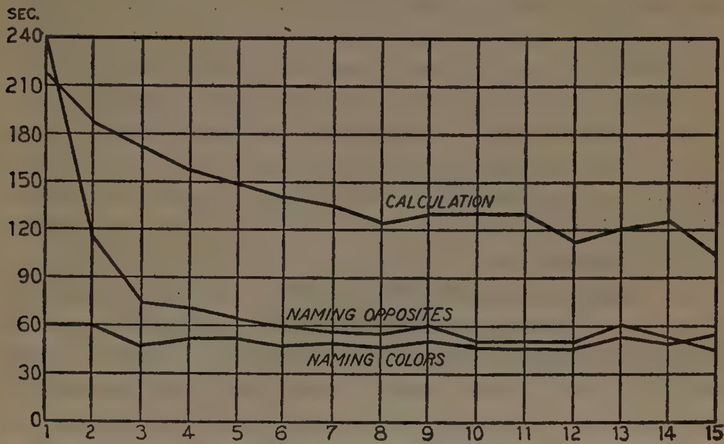

FIG. 23.—LEARNING CURVES FOR THREE DIFFERENT TASKS.

drops very rapidly at first, then shortly flattens out. In Calculation the curve falls gradually from the very beginning.

In part these differences may be explained by the descriptive character of the learning activities. In Color Naming the task is only that of speaking quickly a well-known name for each color. In Opposites, the task in the beginning is chiefly that of finding or discovering just what the precise opposite of a given word is, and this process is added to that of quickly speaking such a word. In Calculation an actual process of "mental manipulation" must be gone through with each time before the answer can even be found, and the progress shown is essentially the rate of improvement in this process or the rate of substituting it for some simpler cue for a more im-

mediate reply. The "speaking time" thus plays a larger rôle in Color Naming, a smaller rôle in Opposites, and a still smaller rôle in Calculation, and the curves reflect such differences in their various forms.

On the other hand, all the curves may be looked upon as different sections of an ideal curve, somewhat resembling that for Opposites. The Color Naming curve looks much like the very last section of such a curve, the Calculation curve like the middle section, and the first section is given in the earlier part of the Opposites curve itself. That is to say, if there were an ideal curve for any learning process, and this curve resembled in a general way that here found for Opposites, the curves of learning actually secured on different occasions might be considered to be different sections of such an ideal curve. The ideal curve would show early rapid improvement, followed by improvement of much lower speed, and finally a long period of very gradual or even of practically imperceptible improvement.

The shape of actual curves would thus reflect only the amount of previous learning that had occurred before the training began, or the number of elements involved in the task which had already been at least fairly well established through previous learning. The analysis of tasks in terms of the amount of previous learning involved in them, therefore, assists in the understanding of the curve of learning which they show, and this is, perhaps, the best generalization that can be made concerning the form of learning curves.

LOSS OF LEARNING THROUGH INACTIVITY

When such code learning as that just described is brought up to a given degree of effectiveness, through training, and then no further trainings are given, the changes in effectiveness with the lapse of time may be measured. It is necessary only to use different groups of subjects, sufficiently large to offset the warping results of occasional striking individual exceptions. The same investigator whose work we have just referred to performed such an experiment, using seven different

groups. In all cases he measured the effectiveness of learning at different periods after eight training sittings had been given to all subjects. The results are as follows:

TABLE VIII

RATE OF FORGETTING

Period of Retention	Efficiency of Learning, in Per Cent	Loss Per Day, in Per Cent
1 day after learning ceased	65.6	
2 days after learning ceased	57.5	8.0
3 days after learning ceased	54.6	3.0
5 days after learning ceased	47.2	3.0
7 days after learning ceased	43.7	2.0
10 days ofter learning ceased	36.0	2.0
14 days after learning ceased	29.0	1.7

It is clear that as time elapses, without further training, the effectiveness established through the learning process gradually wanes. But it does not wane uniformly, as the column giving the approximate loss per day shows. During the first four days they lost over 18 per cent, during the last four days, only 7 per cent. At first the loss is fairly rapid; then it proceeds less rapidly, and after so long a period as two weeks the decline is very, very gradual. This, it will be recalled, is precisely what was found in the studies of recognition. In that chapter it was also shown that "the curve of effectiveness declines, first very rapidly, then less slowly, and finally practically levels out, in asymptotic fashion, ever approaching but not entirely reaching a given limit." This curve is often called the "curve of forgetting."

Instigative potency, acquired through the learning process, thus declines in measurable fashion as the result of disuse, and as a function of elapsed time. The actual amount of loss and its rate depend, also, on the nature of the materials and especially on the degree of perfection to which the process was brought through training, and the amount of "overlearning" or exercise after the establishment of adequate effectiveness. The general results in this connection have been so

well stated by Gates that we quote here his summary, and give also in Figure 24 a set of hypothetical curves presented by him.

From the experimental studies, which are unfortunately very few, it appears that the rate at which connections lose strength through disuse depends mainly on how strong they were at the beginning of the period—that is, on how much they were overlearned. Reactions greatly overlearned, such as our names, the A B C's, and many familiar words, or motor acts as holding a pencil, or humming "Home, Sweet Home," will probably function after thirty, forty or more years of disuse, although they will have lost more or less of the original promptness and ease of action. Names of old friends, the appearance of the scene of a summer's vacation, a poem or song greatly overlearned, the act of catching a baseball, and other acts representing connections less thoroughly established will remain above the threshold of reaction for many years, and thus by various degrees we may come down to responses that were originally exercised sufficiently to place them barely above the threshold of reaction. It is upon functions barely learned that most of the experimental studies of the effects of disuse are based. . . . [The graph here reproduced] illustrates roughly the probable curves of disuse which may follow various stages of overlearning. These relations, however, are merely estimates based upon the few facts now available. They are intended to present roughly the general facts that the rate of loss through disuse depends upon the degree of learning and that loss goes on both above and below the threshold of response.[3]

THE LEARNING OF VERBAL MATERIAL

Many studies have been made of the "memorization" of verbal series. Sometimes these have been directed toward the process of learning, sometimes toward the technique of tuition, sometimes toward the conditions of permanence of what was once learned. In order to avoid so far as possible the effects of "previous learning," it has been customary to use nonsense syllables more than any other material. But numbers, disconnected words, prose, and poetry have also been used. Sometimes the measure has been the number of repe-

[3] A. I. Gates, *Elementary Psychology* (copyright, Macmillan Company, 1925; reprinted by permission), pp. 330-332.

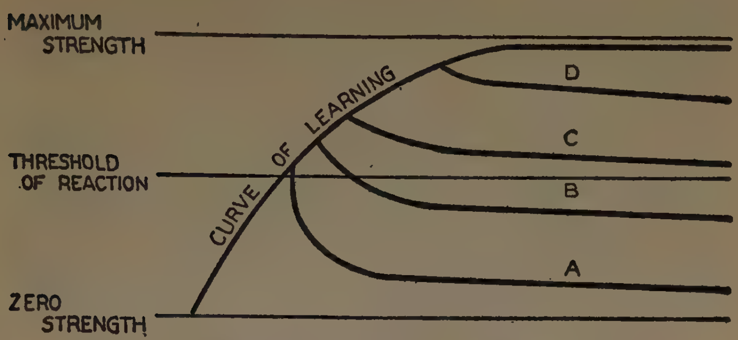

FIG. 24.—FORGETTING AS RELATED TO DEGREE OF LEARNING.

Curve A shows the loss or forgetting which occurs when the function is barely learned. The initial loss is rapid and great, followed by a much slower rate of deterioration. B, C and D show probable losses in functions which are overlearned slightly, considerably, and greatly, respectively. In all cases, after the rapid initial loss, the strength of the connections steadily but slowly decreases. From A. I. Gates, *Elementary Psychology* (copyright, Macmillan Company, 1925; reproduced by permission), p. 331.

titions needed to effect a given capacity for performance, a given degree of stimulus reduction. In other cases, a fixed number of repetitions has been used, and the measure is the percentage of correctness resulting from this amount of training. Again, use has been made of the work necessary, at a later time, to master the same material, thus affording a measure of the saving effected through previous training. The results of these studies vary considerably with the conditions, the personnel, and the materials. We need only suggest here some of the more general findings that have been reported. All of these conclusions are subject to qualification in terms of the particular materials, conditions, and other factors.

1. Nonsense material is less easily learned than is meaningful material. This follows naturally from the fact that meaningful material already represents a certain amount of previous learning, since it is through learning that meaning arises.

2. Materials are more easily learned if they are presented in such a manner as to facilitate rhythmic or other grouping.

In such grouping the detailed features of the group patterns afford additional cues, such as position, accent, and temporal variations.

3. If we mean by scoring time the interval elapsing between a cue and its instigated consequent, it is in general true that sequences having short scoring time will also represent more permanent learning. Thus in the case of equivalent terms in two languages, those translations which I can now make most quickly are likely to be the ones I will remember the longest, other things being equal.

4. The number of needed trainings for perfect mastery or reproduction of a verbal series varies with the length of the series. In general, of course, longer series require more sittings or repetitions, but the precise relationship varies somewhat with the material and with the criteria or measurements employed. In general, however, there is a law of diminishing returns, at least with meaningless materials; more than twice as many repetitions will be required if the length of the series is doubled. In one careful set of experiments, the repetitions required for the first correct reproduction of series of nonsense syllables was as follows: For series containing 7, 12, 16, 24, 36 syllables, the repetitions required were 1, 17, 30, 44, 55 respectively.

5. The occurrence of a sequence "*C* leading to *D*" immediately after the occurrence of a sequence "*A* leading to *B*" is often found to inhibit or weaken the sequence first occurring. This has been called "retroactive inhibition." This is especially the case if the sequence "*A* leading to *B*" is still in an initial learning stage. For this reason it is often suggested that a period of relative idleness is favorable to the "consolidation" of a pattern of learning just practiced.

6. In a series "*A* leading to *B* leading to *C* leading to *D*," it appears that *D*, for example, is instigated, through training, not only by its immediate antecedent, *C*, but also, with decreasing strengths, by the more remotely foregoing antecedents *B* and *A*. Such instigative potencies have been called "remote associations." They can be demonstrated by relearning old series in new orders.

7. It is commonly reported also that "retroactive associations" are established. In such a case, in such a series as "*A* leading to *B* leading to *C* leading to *D*," the forward learning of the series would also establish tendencies for *D* to lead backward to *C*, and so on. But the evidence for these reverse connections is inadequate, and it has more recently been suggested that the appearance of such connections is due to the fact that either through the mode of presentation, or in "reviewing" the series, actual forward connections are slightly established by occasionally moving backward over the series.

8. If the potency of a cue *A* to lead to a consequent *B* is quite well established, the subsequent learning of "*A* leading to *C*" is often found to reënforce or strengthen the potency of *A* when "leading to *B*." But if the "*A* leading to *B*" sequence be not at all established, or only slightly perfected, the formation of the sequence "*A* leading to *C*" tends to interfere with the "*A* to *B*" sequence. That is to say, redintegrative sequences to the same cue when well established may tend mutually to reënforce one another; when feebly established, they tend instead to produce mutual interference. This is simply because, whenever *A* is present, it tends to instigate *whatever* consequents have followed its former contexts. The actual relations will vary in numerous ways with the actual incompatibility of the consequents.

It follows from these results, for example, that if two foreign languages are simultaneously learned, they are likely to interfere one with the other. But if the learning of one is postponed until the other is fairly well mastered, the learning of the second may even improve the mastery of the vocabulary of the first.

9. After a certain amount of learning has been accomplished, an attempt at recitation or performance from partial cues is found to be more effective than is a mere repetition of the total context with its consequent. The attempt to recite an already partly learned poem, that is to say, more effectively establishes what has already been learned than would a single extra reading of the material. But the difference is less marked in the case of meaningful material than in the

case of nonsense learned by rote. And the advantage of recitation is more marked in deferred tests than in tests of immediate proficiency. The general principle is that the more closely the practiced sequence approaches the form it is ultimately to assume, the more expeditous is the learning.

10. In several experimental comparisons of learning verbal material by the "whole" method and by the "part" method, the former has been found more economical. Thus, in one case, poems about eight pages long were learned both by reading the whole poem thrice daily until it could be recited (whole method), and by learning a verse each day, then reviewing the whole to effect perfect recitation (part method). The part method was found to require nearly one-fourth more time, in learning, than the whole method.

The opposite results have been found in some cases of non-verbal learning (such as manual mastery of a maze when blindfolded) so that it is not safe to generalize too broadly. Even in the case of verbal material it seems clear that if the series is sufficiently long it might never be mastered by rote by the whole method, although by the part method at least certain sections could be brought to the point of recitation. When the whole method is found superior it justifies the general principle that a sequence is best learned in the precise form in which it is to be ultimately performed.

11. Another interesting finding is that commonly referred to as Jost's law. At a given moment the strength of "*A* leading to *B*" may be just equal to that of "*X* leading to *Y*." But if two such tendencies of equal strength are, nevertheless, of unlike age, they show striking differences in spite of their apparent present equality. The one representing old learning will be more easily improved by new training and will suffer less from disuse through a given lapse of time. In general, if two instigative tendencies are of like strength but of unlike age, the older is more affected by new training and less affected by disuse or lapse of time.

The less influence of disuse is explained by the "curve of forgetting." In the case of the old tendency, the strength now remaining is the slowly changing residual surviving a long

time after an initially higher effectiveness. But the connection newly learned will at once suffer from the early rapid decline so characteristic of the first part of an ordinary forgetting curve.

The greater effect of training arises from the fact that the lost effectiveness is not entirely lost. It might show itself, for example, in recognition, though inadequate for recall. There are continuous degrees of instigative effectiveness, ranging from adequate potency for reproduction, through effectiveness for recognition only, to lower degrees which can be demonstrated only by subsequent greater ease of relearning. For it is easier to restore skills once learned and forgotten than it is to acquire new skills of the same original difficulty. In the case of the old tendencies, therefore, relearning can take advantage of these lower degrees of effectiveness which lie below the threshold of "reproductive" potency.

A TYPICAL EXPERIMENT IN VERBAL LEARNING

By way of illustrating some of the problems, methods, and results of the quantitative study of verbal learning, the following experiment will serve. It is a group experiment of the sort that is often conducted in psychological laboratories for such purposes as that for which we have employed it. In this particular case the experiment has been performed many times on different groups of subjects. Naturally, results vary somewhat from group to group, especially if the numbers of subjects are relatively small. In the table there are here given the results for four separate groups, and these four sets of data are then combined to give more reliable indication of the facts when they are based on the study of over one hundred individuals.

We have already seen that such factors as primacy, recency, frequency, and vividness have something to do with the establishment of potency of a cue for its consequent. The experiment attempts to investigate the relative importance of these factors and to secure quantitative measures of their effectiveness as tuitional devices. Each letter of the alphabet is arbi-

trarily assigned a two-place number as its equivalent. Thus: *B* 35, *A* 58, *Q* 61, and so on. As in code learning, the learner is required to master these equivalents, so that when a given letter appears he can speak or write its number.

Letters and their corresponding numbers are presented together, side by side, on large cardboard rectangles. There is but one presentation series, in which the letters appear not alphabetically, but in random order. Some letters appear only once, and of these some appear very early in the series, some later, some toward the end, and some very near the end. Some letters, on the other hand, appear two, three, four, or five times, always with the same number. And in some of the letters which appear but once, special vividness devices are employed. Thus one letter and its number are unexpectedly large (magnitude); in another case a new position is used, the number appearing under the letter instead of alongside it (novelty); in another case the letter and number appear on a background that is faintly colored, and in another on a brilliantly colored background (color); in another case an arrow connects the two, pointing from letter to number; in another case a rational (previously learned) connection is present, thus *X* 10, or *C* 100, or *L* 50.

Letters appearing but once and in the middle of the series thus serve as normals; those appearing early or late in the series represent the influence of primacy and recency; those appearing more than once give instances of various degrees of frequency; and the special modifications provide different forms of vividness. After the presentation series is completed and a brief period intervenes, the test is given. The letters are presented alphabetically and each subject must write, for each letter as it comes, either the first number that comes to mind or the number which he believes to belong to that letter. Degrees of correctness are also recognized so that even partly correct responses are given some weight. When the group results are combined, each letter thus receives a score indicating the degree to which it effectively instigated the consequent (number) previously associated with it. On this basis the relative effectiveness of the various devices may be meas-

ured and compared. In the following table there are given the results of four such experiments, and also their combined values, for a total of 116 individuals.

TABLE IX

AN EXPERIMENT IN VERBAL LEARNING

Devices	Experiment 1 17 Cases	Experiment 2 25 Cases	Experiment 3 30 Cases	Experiment 4 44 Cases	Averages 116 Cases
NORMALS					
Average of 7 letters	100	100	100	100	100
PRIMACY					
First in the series	191	80	127	110	127
Second in the series	77	132	135	58	100
Third in the series	103	111	106	101	105
RECENCY					
Antepenultimate	104	109	93	111	104
Penultimate	115	79	91	96	95
Ultimate	173	174	116	124	147
FREQUENCY					
Appearing once (normal)	100	100	100	100	100
Appearing twice	146	126	114	113	125
Appearing three times	164	144	191	168	167
Appearing four times	230	215	188	193	207
Appearing five times	220	288	205	192	226
VIVIDNESS					
Magnitude (one member)	108	64	...	79	84
Magnitude (both members)	108	79	96	106	97
Novelty (changed position)	115	100	66	73	88
Faint color background	85	88	35	73	70
Strong color background	85	105	71	96	89
Mechanical connection	143	176	108	143	148
Seen and also spoken	173	...	135	140	149
Rational connection	246	217	200	173	209

The results as shown in the column for average values are very definite, and with occasional exceptions the separate experiments tend in the same general direction. Using as the unit (100) the value of the normals, in each experiment and in the averages, it appears that, under the circumstances and

with the materials of this investigation, primacy and recency are notably effective only in their extreme forms. The most prime (first) and the most recent (last) have definitely higher values, and recency (147) has a higher value than does primacy (127).

The effects of frequency are clearly shown, but the "law of diminishing returns" is also definitely indicated: the effectiveness increases, but less rapidly than the number of repetitions. There is, in fact, a logarithmic relation between the two factors. Effectiveness varies as the square root of the increase in frequency, approximately; that is, the number of appearances must be quadrupled in order to double the effectiveness of learning. The first degree of primacy (127) is now seen to be equal in effect to two appearances (125). The strongest degree of recency (147) is more effective than two appearances, but not so effective as three.

The effects in the case of vividness are surprising to many not familiar with the study of learning in quantitative terms. All except three of the vividness devices are positively detrimental to the process of learning: they are distractions, interferences, rather than aids. This probably results from their irrelevance; even when noted they do not act as facilitating cues. But the mechanical arrow, graphically and occularly reënforcing the step from letter to number, is as effective (148) as the extreme degree of recency, and better than two appearances. If the material, when presented, was not only seen but also heard (spoken by the experimenter) the effect is about the same in amount. Most conspicuous of all is the effectiveness of a rational connection (209). This, of course, is because a rational connection is simply a connection already partly established; the sequence is meaningful, and some of the learning has already been accomplished in the previous experience of the individual. Such a rational connection is as valuable as four appearances of the material. It is clear that, in general, efficient learning should seek to find, wherever possible in the materials, meaningful relations. Herein lies the very considerable difference between "logical" and "rote" learning or the learning of non-sense.

THE ACQUISITION OF TECHNICAL SKILLS

Many careful studies have been made of the method and rate of learning in the case of such technical skills as telegraphy and typewriting. These differ essentially from the processes we have just described only in their complexity. In all cases the significant feature of the learning seems to consist in the facilitation of acts by the reduction of the cues required for their instigation. But because of the complexity of the activities, certain features appear that are not so strikingly shown in simpler learning processes.

Thus consequents may be organized into more elaborate patterns or what have been called "higher units." This happens whenever acts that have each required a separate cue are jointly or serially instigated by a single cue. Thus in typewriting, in the beginning the word "boy" must be written on the basis of very complicated antecedent contexts. The word is seen, and probably spoken, and it is spelled, each letter being in turn located on the keyboard, and the appropriate key struck. The cue to each movement is the sound and sight of the letter, and it involves identifying letters on the keyboard with the letters seen on the page.

But, in time, instead of these detailed cues being used, the mere sight or sound of the word "boy," which has always been a feature of this elaborate context, becomes linked with the whole movement series, and the eye is freed from the keyboard and need only follow the copy. The word is then written as a "word unit" rather than as a combination of "letter units," and it is clear that this is accomplished through a reduction in the required cue.

The technique of teaching typewriting effectively affords several useful suggestions for technical learning in general. In some cases it seems best, in mastering a new feat, to begin with the act as a whole, and to proceed by gradually mastering the constituent processes. Thus in learning to make bread this is probably a useful method. This is the equivalent of the "whole" method as it has been studied in the case of verbal learning.

But in such an activity as typewriting, to begin with the whole process of transcribing printed copy on the machine, establishes habits and cues which must later be overcome. The amateur begins by relying on solely visual cues, and must always look back and forth from copy to keyboard. After prolonged training he will, to be sure, come in time to locate tactually and kinæsthetically the various keys, especially those most frequently used. But he is likely to use only one or two fingers of each hand, and this makes it impossible to develop a system of tactual and kinæsthetic cues which the "touch method" makes possible.

Consequently, it is found best to begin by mastery of the keyboard, first in visual terms with reference not to the machine itself, but to a diagram on the wall. Thus each finger has its proper key, and visual preoccupation with the keyboard of the machine is never encouraged, is, in fact, rendered impossible in many cases by concealing the keyboard from view. As the kinæsthetic and tactual cues come in time to be effective, or to be closely bound up with the mere visual appearance of letters and words, or even with their vocalization or their auditory imagery, the learner shifts from diagram to copy of the strict sort. In a sense, then, he has been using the "part method," first mastering the keys, then undertaking to improve his speed in connection with the transcription of meaningful material.

In such complex processes it may sometimes happen that many repetitions in terms of lower units are required before the higher units are ready to function. When they do come into use, however, there is likely to be marked increase in speed of performance, following a period of relatively slow change. Such a slow period has been called a *plateau* in the learning curve. Plateaus in an actual case may also arise from such factors as slump in interest, distraction, fatigue, artificial methods of scoring (as in tennis), in which small changes are not registered until they make a difference of some conspicuous sort (a game or a set, in tennis). They may also appear because at some point a change of method results in rapid rise in skill. Thus if in practicing "adding 7," one sud-

denly ceases to do precisely this and starts to "add 10 and subtract 3," such a change may occur in the recorded curve. Practically, then, plateaus may justly be called "critical periods," whether they be due to slow but unrecorded learning or, on the other hand, to the failure to adopt a superior technique. They are also critical in practical life since many learners may be discouraged by their length, and thus fail to take those steps or make those efforts which might result in their disappearance.

One of the causes of slow progress in much human learning comes from the worker's being "wedded to a technique." Thus he may persist in relying on one type of cue, not daring to try out reduced ones. Or he may merely, through having identified himself with one method, stand by this method through motives of pride, when better methods could be easily established. For such reasons what has been called "the determination to improve" is found to be an effective determinant of the rate of learning. This is not because motives in any occult way act upon activities, but because with such intention to gain, a search may be made for better techniques, and each indication of a better method of work may be eagerly adopted.

An important fact for human learning is that "reflective analysis" or "rehearsal" may be found profoundly to influence the rate of improvement. This is because, as we have seen, much reflection is actual symbolic execution of acts which might be performed on a larger scale. Thus the general, manipulating the pins on his wall map, was practicing army maneuvers in a very genuine sense. As I lie in bed I may rehearse the operations of driving an automobile, which I am just learning, by actually making tentative movements, only symbolically representing the crises for which they are appropriate. "Mental rehearsal" of a process is, therefore, the execution of it in symbolic or partial terms. It is probable that such rehearsal is a distinctively human accomplishment, and this very capacity for learning in the absence of the situation, in the interest of which the learning is done, may be one of the reasons why human learning is so far superior to that

of other animals. What is often reverently called "insight" is only such "symbolic rehearsal" in which, in the light of past learning, objects are "mentally manipulated," that is, acted upon in terms of their partial features or symbols.

Studies have also been made of the influence, on human learning, of such varied factors as competition, presence of fellow workers, change of activity or novelty, knowledge of results, stimulation by prizes, and so on. The results are rather complex and vary considerably with the circumstances, so that no attempt can be made in this brief survey to summarize them. The significant thing is that almost every conceivable feature of a learning situation has something to do with the course of improvement. This we should, of course, expect, since we look for every detail of an antecedent to have some degree of redintegrative potency, especially after the course of many repetitions. Even such slight things as a change of room or chair or dress have been shown to exert measurable effect on the course of work or learning, and individual differences or idiosyncrasies in this respect are conspicuous.

THE SIGNIFICANCE OF PRACTICE LIMITS

We may roughly divide the course of the typical learning curve into three successive sections. The first would be the *primary slope,* in which there are so many and such easy changes recorded that the curve drops or rises rapidly, depending on whether time required or units of work accomplished be used as the unit of measurement. The next section of the typical curve, representing slower but very appreciable change, might be called the *secondary slope.* There remains then the *final slope,* the very slowly changing section, in which measurable changes are scarcely if at all perceptible.

This final level, beyond which the curve fails to pass consistently or permanently, we may call the *practice limit.* Practice limits are in some ways the most significant features of learning curves, although they have in the past received scant consideration in psychological accounts of learning. In

the first place, three rather different sorts of practice limits may be distinguished. We may call these (*a*) the cognitive limit, (*b*) the motivation limit, and (*c*) the physiological or mechanical limit.

The cognitive limit represents a level of performance which, for a given individual and material, is the best that can be achieved by the method then employed. Thus by the "eye and finger" method, there is a limit to the rate at which I can transcribe copy on the typewriter. If I "know no better" (cognitive limitation) than to continue this method, my performance cannot improve beyond this limit. But by adopting the "touch" method my performance might in time much exceed this standard. The cognitive limit is thus a function of the method used and the degree of understanding with which the individual proceeds. It may, of course, be also a physiological limit for such circumstances.

The motivation limit is the level beyond which an individual does not improve with a given incentive. To "do one's best" is always a variable, depending for one thing on the inducement or motivation of the act. People are often surprised that under pressure of excitement, fear, rage, or competition they reach levels of performance to which ordinary situations had failed to carry them. Even a long continued and apparently final level on a curve of learning may often be left behind and a superior level attained through adequate motivation, as for example by reward or punishment.

Both the cognitive and the motivation levels are, therefore, often inferior to that necessary limit set by the physiological and physical conditions of activity. Physical instruments, such as nerves, muscles, and bones, impose ultimate limits upon the reaches of animal behavior. Reflexes appear to have their characteristic "action times," though these differ with the reflexes in question. Light and sound, as "stimuli," travel at different rates. Muscles have their fixed ranges of contractility, and bones their unalterable arrangements of leverage. For every task there may, therefore, be conceived a final limit of practice, set by the physiological features of the structures concerned in its performance. Thus in the case of rapid-

ity of such an act as tapping with the fingers, the physiological limit is set by such factors as the latent time and the refractory period of the neuromuscular structures involved. In naming opposites the physiological limit might be supposed to be the maximum rate of articulation. In the case of auditory and visual reaction times, the limit is in part determined by physiological characteristics of the two sense organs, the eye, with its relatively slowly moving chemical activities, and the ear, with its relatively more prompt mechanical mode of stimulus conduction.

It is an important fact that, under otherwise constant conditions, individuals differ widely from one another in respect to all these levels. Thus the performance of practiced typists will vary with (*a*) the technique and comprehension, (*b*) the incentive and zeal, (*c*) the constitutional psychophysical make-up of the individuals concerned. One of the most significant features of an individual or system is revealed by these idiosyncrasies in the limits of possible training. The three types of limit reflect individual peculiarities on the three general levels already often encountered in our discussion, the symbolic, the affective, and the postural levels.

Not only do individuals differ in the limits of possible training. Such a limit in one type of performance affords also a significant index of the general "quality of the organism." For "good learners" are not only initially and ultimately superior in the thing practiced and in the rate at which they approach their maximum therein; they are "good" in many other activities as well. They are also superior in many apparently diverse respects, important for the welfare of the individual and the species. Thus among human beings "good learners" appear also to be characterized by superior intelligence, superior stability and control, superior physique and health, superior resistance to the damaging effects involved in "nervous breakdown," and even to the influence of drugs and poisons or infections. Even personal comeliness, bodily grace, and longevity appear to be positively associated with superior learning capacity. Of course, the correlation is not perfect, and there are numerous exceptions to the general rule.

But the actual amount of correlation of "desirable traits" may be measured, and it is sufficiently high to justify some such general concept as "the quality of the organism," which may be generally high or low, along a continuous scale. Such positive correlation is more strikingly apparent when individual status is measured not by momentary or initial achievement but by the *limits of practice* in each respect. Let each be given opportunity to attain his or her limits of achievement in various activities. When such final limits are reached, those who excel in one type of performance tend strongly also to excel in others. The positive correlation of desirable traits becomes increasingly obvious as practice limits are approached although it is seldom perfect.

Thus in one investigation thirteen human subjects were studied as they practiced six tasks until their respective limits were reached after more than two hundred training periods. The tasks were such varied performances as (*a*) speed of tapping with the hand, (*b*) visual-motor coördination as in target-hitting, (*c*) discrimination reaction-time to brightness stimuli, (*d*) rapidity of color-naming, (*e*) vocalization of antonyms to presented adjectives, and (*f*) mental calculation as in adding.

At the first trials the intercorrelation of these proficiencies was only +.06. By the fifth trials this had risen to +.28; by the twenty-fifth to +.32; by the eightieth to +.39. When practice limits were approximated in all cases, after two hundred trials, the median correlation had reached +.50. With protracted learning in all activities, then, the intercorrelation of proficiencies, which in the beginning is slightly positive, becomes more striking. The coefficients of correlation remain positive and become greater, the longer the practice is continued, until the limits of learning are reached.[3]

[3] For detailed discussion of these topics see G. S. Gates, "Individual Differences as Affected by Practice," *Archives of Psychology*, No. 58 (1922); and H. L. Hollingworth, *Vocational Psychology* (D. Appleton and Company, 1916), Chap. XI. For the technique of computing correlations, consult any modern textbook of statistical methods.

LEARNING IN THE LOWER ANIMALS

We can refer only briefly to the learning of simpler than human forms of animal life, and this only for the purpose of showing that even in the simplest forms responses may come to follow upon reduced cues. That is to say, the simplest animal forms studied exhibit mental (redintegrative) activity, although no authentic instances seem to have been observed in the case of plants. One of the simplest microscopic forms is the Paramecium. This animal has been studied by several investigators. Typical results show that even this simple, microscopic animal, with neither nervous system nor brain, can nevertheless learn.

Thus in one case a glass tube was prepared, so fine that only a single Paramecium could get through it at a time. The tube was partly filled with water and a single animal allowed to swim up the tube to the surface of the water. It acted toward the surface film as to any mechanical stimulation. The characteristic reaction was darting backward, rolling over towards the aboral side, then swimming forward again. Ordinarily this behavior succeeds in enabling the Paramecium to avoid an obstacle encountered in its path. But in the present instance the narrowness of the tube prevented this result and simply brought the animal again up to the surface film. This performance was gone through several times. Then the Paramecium modified its behavior. By doubling up its body, it succeeded in turning about completely in spite of the narrowness of the tube.

On being repeatedly put into the same situation, this animal gradually required fewer and fewer trials of the unsuccessful variety. In time it doubled over almost immediately upon striking the surface film, thus exhibiting an undoubted and definite type of learning.

Too much should not be made of the fact that such cues as were effective with the Paramecium soon lose their potency. It is, to be sure, true that the simple animal does not long remember what it has learned. But even human learning, as we have seen, soon deteriorates unless it is used or is much over-

learned. And some very simple forms, such as the earthworm, have been found to learn adjustments which they remain able to execute after a respectable period. Thus Yerkes experimented with earthworms, which naturally move towards a dark rather than a bright region. The earthworm, admitted into an experimental box, might move toward either a darkened or toward a bright chamber in the course of its further activity and its exit from the box. But in the way to the dark chamber or outlet was placed sandpaper which so interfered with the worm's progress as to render its movements futile. After some preliminary squirming "investigation" the worm moved away through the light chamber instead, how accidentally we cannot say.

But it was found possible to "train" such an earthworm, so that this "futile" preliminary activity was not required before the unnatural path was followed. In the course of time the "random movements" and "false starts" became reduced, and the time required by the worm to emerge from the box was much decreased. We need not here speculate concerning the nature of the cues employed by an earthworm, but it is clear that, whatever they may be, a genuine reduction in the antecedent came about, so that the originally long and fairly complex performance was no longer needed as an antecedent. Slight cues in time became effective so that it appeared to the observer that the worm "directly" followed the path for which it had been necessary to train him by many repetitions.

We may conclude our discussion of learning by quoting Woodworth's brief summary of the results of many such experiments on a large array of animal forms. This author, after referring to typical learning experiments on lower animals, writes as follows:

> A comparison of vertebrates with invertebrates, and of higher with lower vertebrates, shows little that is essentially new in kind in the learning of the higher animals; but it does reveal a great increase in fertility and readiness of modification. Reptiles, as represented by the turtle, learn more quickly than amphibia, as represented by the frog, or than fishes. Birds and mammals, on the whole, learn better than the lower classes of animals. Among mammals, monkeys

certainly learn more, and more rapidly than do rats, mice, or dogs and cats, while the raccoon seems to stand, in this respect, intermediate between the cat and the monkeys. The various orders, families and genera differ in the time required for the formation of a habit, in the complexity of performance, and in the variety and number of the performances which they are capable of acquiring.[4]

[4] Ladd and Woodworth, *Physiological Psychology* (Chas. Scribner's Sons, 1911), p. 547.

CHAPTER XIV

MEMORY AND THE PROCESS OF RESTORATION

THE NATURE OF RECALL

Two puzzling topics in the history of psychology have been memory and imagination. The puzzle has arisen in part because of the loose way in which these terms are used, both in science and in daily life. It depends also in part on erroneous conceptions both of mind and of nature. Other words connected with these topics come in this way to carry the same confusion.

Consider, for example, the common use of the word "recall," a word much employed in discussions of memory. Thus the cook congratulates herself that (as she in common with psychologists is likely to say) she can "recall the ingredients" of the dish she has just prepared. Of course, she has long ago learned that ingredients, once cooked, cannot be summoned back, as one can "recall a witness" to the court room. Events once past can never be recovered in this sense. I cannot actually "recall" the house where I was born, for it was long ago torn down. I cannot literally re-call my grandfather, for he is no more. Whatever memory may be, in the sense of recall, it is obviously not the resurrection of the past. Nevertheless, common speech and many psychological textbooks suggest that such "reproduction" or reinstatement does occur. What precisely then *does* happen in the case of memory? The word applies to so many situations that we can best take them one at a time, and gradually disclose their common features.

In a very literal sense, I can re-call a fact (or an ingredient) in that I *call it again*, that is *name it* once more. I *call* my terrier by speaking his name. After he scampers away I re-call him by naming him again. And the name used in the

re-call may not be the original "baptismal" name, but a pet name or an abbreviation, that is, some other surrogate or symbol—a synonym. And even years after, when he is no more, I can recall him, in only a slightly different fashion. I speak or imagine his name, and this detail, as a surrogate for the animal that he was, evokes an array of feelings, images, postures, gestures, and further words, descriptive or appreciative. So potent is the name that it still leads to adjustment or description not inappropriate to the actual presence of the terrier, though probably incomplete in many ways. Such incompleteness, as we have abundantly seen, is often, if not always, characteristic of the consequent instigated by a cue detail. Hence the emotions thus aroused may be weak and the description somewhat faulty.

Nor are names the only cues that thus function for past contexts. A visual image might serve equally well, or any attitude, gesture, object, place, or other feature "in class with" details that were part of the original life of my dog and myself together. The occurrence of any such detail would be an identification or re-membering, provided only that it lead to appropriate consequent by way of adjustment or description.

THE MEMORY CONSCIOUSNESS

"I remember the house where I was born" when any detail, in class with original features of that context, adequately "leads on" so as to act, for a given purpose, in place of the presence of that house. Thus if a present visual image or a series of gestures or eye movements provides spatial cues that enable me to make a pencil sketch which would be recognized as "that house," I have remembered it. Or if, instead, the cue be used only to lead me to the house or to estimate its size or to describe it in verbal terms, I have remembered it, have re-called it. And in the ordinary case such "recollection" actually involves an identification, naming, or description suitable to all or part of the past object. Such a report may, however, be made "to myself" only, in whatever alphabet I most commonly employ for "self-communion." It may take

the form merely of that vague posture and distribution of muscular tonus which I know kinæsthetically as "feeling confident" or "feeling at home."

The essential point is then that the memory of an object or event is not a resurrection of it. Instead, it is some present event which, as a cue or instigating detail, functions redintegratively for the original context. We thus remember a past event by encountering a new event, which is an associative surrogate or symbol for the past event. This present symbol need not even be an "intraorganic" one, although it often, perhaps usually, is. It may be an actual scene, a photograph, a piece of music. Looking at the photograph, it instigates the appropriate act of report, and we say "Why of course, I remember him. He sat in the third row, etc." The cue evokes appropriate descriptive report or adjustment. It operates in place of the past or the absent.

So effectively may such cues operate that we fail to report them as such, and this failure of report is what we mean by their being unconscious. Instead, we more commonly report the context (past event) for which they act or which they mean. The report which we give is thus a synonym for the cue itself, another set of symbols for the same object. It is, therefore, true enough to say that it was not the cue but the past object of which we were at the moment conscious; that is, which we reported. But this, as we have seen, is the common difficulty of "introspection." The report is likely to be "an equivalent symbol" of the cue, hence not a description of *it* but of the context for which both symbols function. This has been called "the stimulus error" in the history of psychology. To commit the stimulus error, in "introspection," is to give *another symbol* for the past object rather than to describe the symbol now active. It is this "error" that has led to the popular idea that "in memory" past events and absent objects are mysteriously resurrected, and flit "through the mind" in ghostly form. Actually however, such objects are never *in the mind;* they are *in history* or in the social world of abstract space. The field of mind is only the field of symbols, redintegratively operating.

FURTHER MEMORY SITUATIONS

From this analysis, it is easy to see how the term memory has come to be applied freely to redintegrative situations in general. Thus the problems we discussed under learning are often considered as aspects of memory. In fact, the classical experimental study of verbal learning, in which Ebbinghaus reported his protracted study of the learning of nonsense series, was entitled "Memory."

Experiments on the distribution of training are often called studies of the economy of memory. Studies of the influence of periods of inactivity, of the deviations of cue potency, are called investigations of retention or of memory loss. The measured effectiveness of such cues is commonly called the "efficiency of memory." The repetition of the consequent, as in naming syllables once learned, reciting poems, transcribing codes, is called remembering these materials.

The same thing is true in non-verbal activities. We are said to "remember how" to skate, to swim, to typewrite, to drive a car. We remember a piano composition once "learned by heart," when we can satisfactorily play it, relying only on the kinæsthetic cues to which it was once reduced.

In these cases too the word "recall" is much employed, but usually in a new sense. Here it is not the original context that is said to be recalled. Instead, the response or consequent is recalled. Thus I recall the *movements* of skating, the *fingering* of the piano, and the *manipulation* of the fingers on the keyboard of the typewriter. Although there is an inconsistency of terminology in all this, the reason for it is clear. For here, also, we have to do with the instigation of consequents by cues. The consequents evoked, however, are non-verbal and are not conventionally thought of as *synonyms* of the cue or as *reports* of the past context. The process involved is the same, that of redintegrative sequence. The names are loosely applied now to this and now to that aspect of such a procession.

"Memory" and "recall" are also paradoxically employed for still another situation, in which something is said to be re-

membered that has not yet occurred. Thus I remember what I am going to do this afternoon. I recall the hour when I am to see the dentist to-morrow. This again is only "freedom of speech." What I recall is the verbal, gestural, or imaginal form of the purchasing instructions or the terms of the dentist's appointment. These were past events. They are recalled only in the sense that some cue provokes their names or some synonymous report of them. So also I am said to re-mind another person of a prior fact when I supply him with a cue that functions for that antecedent complexity.

Practically, it is important to realize that memory always involves the activity of cues. Things are not remembered out of the blue sky or in the air. Whether the evoked response be a manual dexterity, a verbal report, an adequate image, or an appropriate emotion or attitude, the same rule applies.

In another paradoxical sense we may remember to do things we did not intend to do, just as we may "recognize" things we have never seen. As we shall see more clearly in connection with reasoning and motivation, effective mental life commonly involves the joint participation or constellation of many instigative tendencies. But sometimes an isolated cue so effectively operates that its consequent appears irrelevantly or embarrassingly. On Saturday afternoon the elevator to my office on the fourth floor of the college building does not run. On such afternoons it often happens that I call for my mail, start examining it, and later suddenly find myself standing patiently by the door of the dead elevator, futilely ringing the bell, for perhaps the second time. I had "intended" to walk up the four flights. But the stimuli along the first part of the route led me the ordinary school-day way.

Another psychologist had been busy all day, for several days, doing brief experiments on other individuals. Each time, she had to say "Ready, go!" On one occasion the telephone rang. She stepped to the instrument and in the customary snappy voice said, "Ready, go!" Here the potency of a single, though complex, situational cue, *being ready to have some one begin something,* provoked its well established consequent.

Another person is seldom at home during the day and uses the bathroom chiefly by night. Upon rare occasions, when leaving this room in daylight, he unfailingly reaches up and *turns on* the light as he leaves. The *leaving* cue is definitely linked up with "turning the switch," and it functions effectively. But such effective function of single cues is, in these cases, practically *useful* only when combined with the operation of other cues relating to the present rather than to past situations. So too in "false recognition" the single cue from past contexts is prepotent and overweighs the influence of other cues relating to the present situation. The familiarity, instigated by the cue, is wrongly attributed to the whole present context.

THE EFFICIENT MEMORY

Memory is efficient when the cues required are slight and when they are readily available or likely to occur. "Memory systems," therefore, propose various ways of establishing, as the cues to recall, items that are already well learned They employ the number system, or other items readily available, such as the spatial directions, the parts and furniture of a familiar room, or some artificial set or system of cues that is thoroughly learned beforehand, and applied to all new situations. Even the man who remembers his purchases by strings tied around his fingers is merely seeking to establish effective cues that will be "readily available."

The most useful principle of good memory, aside from the mechanical techniques of training, is here found. New facts can be most effectively remembered by linking their synonyms to cues already well established through the individual's past learning. Find some relation between the new and the familiar. Connect the new fact with systems of knowledge or of interest that are of long standing and that are often rehearsed. This means, therefore, a search for rational or meaningful connections. Their value for memory was clearly shown in the experiments of the preceding chapter. The technique of a good memory is the technique of effective learning.

MEMORY AS RESTORATION

Memory is, therefore, not a process of storing but an act of restoration. The restoration involved, moreover, is not like that in which a thief restores a stolen horse, nor even always like that in which the glazier restores a broken window-pane. For in the former of these the restored item is only a later stage in the history of the original; it is *the same* horse that is re-produced. In the latter case, the original pane is not resurrected, but *replaced.* The replaced item is, however, a faithful or serviceable duplicate, and in this different sense a reproduction. Some cases of memory resemble this. The item recalled is an image or movement which, while it is neither the original object nor the original response, is a satisfactory duplicate. For the purpose of description, art, or industry, it *passes for* the original.

But the typical case of memory is more like that process in which architect and builder restore an old structure. New material is produced, along the lines of, in the relations of, or following the pattern of, the original. It is still more like the process through which an anthropological sculptor restores the skulls of prehistoric men or the skeletons of extinct monsters. With only a jaw bone or a femur as cue, plastic materials are so patterned that, for the purpose of instruction, they are substitutable for the original structure.

Finally, memory is even more accurately paralleled by the process in which an offending person who has grievously insulted us by an overt act of transgression *restores* our pride. He does so, perhaps, by mere verbal or postural surrogates for conceivable overt acts of placation. He offers a verbal apology or, on his knees repents. The parallel with memory here arises from the fact that the restoration is effected, not by a duplication of friendly acts, but by slight substitutes for them.

The restoration involved in memory, then, so far as it concerns past antecedents, is simply the occurrence of new events with patterns or relations which enable the new to function, associatively, for the old. From the point of view

of the consequent, the restoration is the instigation, by some such cue, of some response which, for a given purpose, has the market value of the original act which it resembles. Thus every faithful recitation of an actor's lines is a new and unique event. But for the purpose of author, producer, and audience, one such recitation is as good as another.

SPECIAL ASPECTS OF MEMORY

It is customary to distinguish, under the general head of memory, the four "chief factors" of acquisition, retention, recognition, and reproduction. Acquisition refers to those facts which we have considered under the topic of learning. The interest here lies chiefly in the technique of training and the description of the process of cue reduction. Retention applies to the time relations, as they influence the permanence and effectiveness of the cues that operate at the end of a training period. Recognition applies to the fact that cues not capable of instigating adequate descriptions of past contexts, or consequents of a given market value, may, nevertheless, arouse appropriate feelings or useful and appropriate personal adjustments. These may lie exclusively on the postural or affective levels rather than in the field of symbolism. Reproduction, as we have seen, applies to the fact and character of the instigated consequent. This may be either an adequate description of past or absent situations, or an act of specified market value.

REFERENCE TO THE PAST

Memory is often said to involve not merely recall or reproduction but also the *locating* of the event in the individual's past. Since, as we have seen, the term "recall" is only figuratively applied to such past events, it follows that this fact of "location in the past" is also figuratively described. What are the precise facts which the phrase is used to indicate?

Events as they pass are reported and commonly receive their appropriate place in this system of report. The nature

of this system varies widely from individual to individual. In many cases it is practically a "number form." In this imaginal structure events are systematically and symbolically placed according to their calendar notation. Thus "life" or "time" may be represented as a long and variously curving line, moving from left to right, or from back to front. The localization of an event is its symbolic placement in this imaginal spatial system; time relations are symbolized by spatial relations.

In other cases the system of references is largely a verbal affair. Events are located in the sense that they are described in detail with reference to their correlation with other events. The verbal system is autobiographically organized about such foci as "my birth," "my going to school," "the death of Rover," "my first commencement day," "my marriage." Or it may involve instead a vicariously acquired pattern of verbal "historical references," such as "discovery of America," "settling of Jamestown," "war of the Rebellion," and so on. The *localization* of an event consists of the particular set of verbal correlates from this "logical system" which the symbol of the event arouses. In one case rather carefully observed, the "reference to the past" consisted of a kinæsthetically known system of gestures and movements, whereby the events, as represented, were "thrown" in one or another direction; that is, they were correlated with an adopted system of tentative postures and movements of hands, head, and eyes. The "backward reference," so often described as a feature of "memory consciousness," has in such systems of reference a literal basis. There *is*, therefore, a *feeling of pastness*, which is the report of the arousal of these often obscure contexts, the meanings of which are historical antecedents.

MEMORY SPAN AND FIDELITY OF REPORT

In daily life the term memory is much used for the fidelity with which a context is reported or an equivalent act produced on the basis of a single "impression." Learning, in the sense of gradual stimulus reduction through repeated training, is here inconspicuous or absent. The "memory experiment" in

this sense is a cross section of a conceivable learning series. The antecedent or "presentation" is fixed beforehand and occurs but once. Interest is, therefore, shifted to the character of the report or act which can thereafter be evoked by presenting cues abstracted from the original presentation.

Thus in "memory span" investigations the subject may be told, "Listen to Series C." There is then once read a list of nonsense syllables, words, or numbers at a regular rate. Thereupon, or after a chosen interval, the subject is invited to "Repeat Series C," or may be asked at once to repeat what he heard or saw. Since the stimulus is kept constant for different individuals, and the same rate and mode of presentation used for different materials, the interesting measure is the degree of completeness of the consequent or report now provoked by symbolic reference to the presented series.

For given individuals, ages, materials, and modes and rates of presentation fairly definite span limits are found. The span in a given case is the largest number of items that can, with a stated frequency of success, be "reproduced" correctly and in the original order. Thus, when single digits (as 8, 3, 7, 2, 6, 1, 5, 9, 4) are heard spoken in a given order, separated by one-second intervals, and spoken without rhythm or accent, the average six-year-old child can immediately "re-call" a series containing either two, three, or four numbers. There are, of course, normal and abnormal individual deviations above and below this span. From seven to nine years of age the average "auditory digit span" is five; from ten to sixteen years it is six; above this the average is seven digits. For one hundred college students (freshmen) the distribution and frequencies of auditory memory span for digits is shown in the table on the following page, along with similar data for disconnected words.

Instead of numbers being presented, the experimenter may point successively, and in irregular order, to members of a row of four or five objects (as blocks in the Pintner-Knox Cube Test). The subject is thereupon required to duplicate the pattern of movement just seen. Although the suggestion of counting is carefully excluded, the span limits for irregular

TABLE X

DISTRIBUTION AND FREQUENCIES OF AUDITORY MEMORY SPAN FOR DIGITS AND WORDS, IN THE CASE OF ONE HUNDRED COLLEGE FRESHMAN

Span	Number of Individuals	
	Digits	Disconnected Words
4	0	0
5	5	0
6	23	2
7	29	4
8	20	7
9	18	12
10	4	10
11	1	19
12	0	11
13	0	10
14	0	9
15	0	9
16	0	3
17	0	2
18	0	1
19	0	1
Total Cases	100	100

orders agree quite closely with those for heard and spoken digits. The memory span for words is higher than for numbers, and if the words be logically connected, as in a sentence, the memory span may be as high as thirty or forty words. Apparently in such a case "higher verbal units," such as phrases, and nouns or verbs with modifiers are the "memory elements." The span for such "higher units" closely approximates again that for auditory digits. The "recognition span" is commonly larger than the span for "reproduction," as would naturally be expected.

Fidelity of report, after a single presentation, has been much studied in the "testimony experiments." Here the subject witnesses a complex event, observes a motion picture portrayed, or inspects a picture, the contents of a room or show window, or the like. He may be warned, or not, of the intention to require of him a report of what has occurred. The

interval elapsing before such testimony is required may be varied, the objects or acts experimentally varied, the report may be by "free narrative" or in response to a definite set of questions. Experimental "distortion" of testimony may be attempted, as by asking suggestive or leading questions, disputing the report given, and so on.

Special journals have been founded in which the results of such investigations have been reported over a period of many years. The "rules of evidence" in legal procedure seek to take account of many of the better known tendencies and to improve the fidelity of testimony by exacting oaths, rejecting "hearsay," and prohibiting "leading questions." The accumulated literature in this field of "fidelity of report" is so considerable that no brief summary can do justice to its range and suggestiveness.[1] Instead of attempting such a summary, a brief account of an experiment is here given by way of illustrating the general nature of many such studies.

A QUANTITATIVE MEMORY EXPERIMENT

In this experiment an attempt was made to measure the fidelity and range of testimony of college freshmen, sophomores, juniors, and seniors. From each class twenty-five individuals were selected at random. Each was allowed to examine for a fixed time a picture much used in such experiments by other investigators.[2] After an interval which was the same for all individuals, each student was asked to reply to the standard set of questions concerning the nature and disposition of the numerous items of the pictured scene. Each item was assigned a "credit score," on the basis of the experimentally determined chance of reporting it correctly. Total "testimony scores" were thus secured for each student. These represented the "completeness of report," including also the factor of accuracy.

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[1] See G. M. Whipple, *Manual of Mental and Physical Tests,* Part 2, chapter on "Fidelity of Report" (Warwick and York, 1914).

[2] "The Disputed Case;" see Whipple, *ibid.,* for interrogatory and other data.

In the table of results which follow, 100 per cent is used as the measure of the most complete and correct testimony which the array of questions and their definite answers could yield. The actual results are, therefore, percentages of a theoretically possible perfect report.

TABLE XI

FIDELITY OF REPORT

	Median Scores	Range from Best to Poorest	Coefficient of Class Variability in Per Cent
Freshmen	31.0	56 to 18	24
Sophomores	31.8	49 to 10	25
Juniors	38.5	55 to 19	16
Seniors	37.7	58 to 22	18

The results are sufficiently definite to be interesting and representative. The typical report under such circumstances is only a little over one-third as complete as a report could be if made with the picture before one. Such partial cues as are available are only one-third as effective as the total context which they represent. Freshmen and sophomores give lower scores than do the upper classmen; they are also more variable individually, as their coefficients of variability indicate. The upper classmen thus represent the results of some special influence by way of training or by way of selection. Their reports are both superior and more homogeneous. Finally, individual differences, even among highly educated and selected college students, are great. The best testimony (that of a senior, score 58) is nearly six times as complete and faithful as the poorest (that of a sophomore, score 10). Such individual differences are commonly found.

By such methods as this many quantitative studies have been made. The present experiment readily shows how fidelity scores, confidence scores, range of narrative, reliability of oath, spontaneity of report, and so on may be secured and correlated with such factors as age, time interval, period of

inspection, nature of material observed, and endless like features.

QUALITATIVE STUDIES OF MEMORY

In a somewhat similar way progressive qualitative changes of a consequent or report may be undertaken. Thus we might note the movements of a skater or typist long after the training period, with no intervening practice. These might be descriptively compared with the pattern of the earlier performance at the termination of training. Or if the consequent be a verbal report or an imaginal reproduction instead, the same type of qualitative or descriptive comparison may be made.

Thus Henderson, in an early study of "memory for logical material" noted that in the course of time topics and "ideas" once presented for faithful verbal reproduction were, as shown by later verbal reports, variously modified. Topics were simplified: unimportant terms dropped, words substituted for phrases, similar ideas merged in one statement. New topics from other sources intrude themselves, and original items are quite omitted. Similarities are emphasized, contradictions eliminated. All these tendencies result in a process of generalization, which may easily exceed the warrant of the presented materials alone.

Philippe, over thirty years ago, attempted to study changes in recalled visual imagery with lapse of time. Through training, definite visual images associated with tactual clues (feel of objects in the hand) were recorded by the subjects in the form of drawings. After varying intervals "reproductions" were attempted by the same method. Comparison suggested that such images definitely change with time. They lose their less important details, becoming sketchy and schematic; the image tends, also, to be generalized, to be warped toward the mean of a more inclusive class of which it is a member. It may in this process acquire added details through contamination by other sources.

A detailed study of qualitative changes in the imaginal reproduction of materials formerly learned, after varying in-

tervals of time, has been reported by Crosland.[3] This investigator found that "an observer undertakes to recall learned and retained materials in a manner which is strikingly similar to the procedure he employs in learning them." The typical changes with lapse of time lead to the account of various "mechanisms belonging peculiarly to the process of forgetting."

Through "typification," images lose their details and "in the course of time become more and more schematic and syncopated and ephemeral." It is a process similar in some respects to generalization. In it there are progressive changes in the "clearness" of constituent details; "the details which grow to the maximal degree of clearness are details which are most essential to the integrity of the dominant meaning represented."

Another characteristic tendency noted is called "analysis." It "has its beginning in the shifting of clearness from detail to detail in one image, the more striking and important details standing out very clearly, and the outlines of the material being followed out until dominant *foci* of clearness are reached." As forgetting proceeds this process results in the production of "disintegrated and discrete images which tend to come . . . in a successive, discursive fashion, each being a new entity in itself."

The two chief tendencies in ordinary forgetting are reported to be: (*a*) *dissociation*, which involves "a process of disintegrating and losing of details with a characteristic typifying of contents"; and (*b*) *assimilation*, which is "a process of subjective selecting, interpolating, and clarifying, with its characteristic mechanisms of condensation, transposition (displacement), and elaboration."

It is clear that such changes in the pattern of memory are not limited to modifications of imagery, of the various sense modes. They are characteristic of the whole set of events involved in learning and in recall, of the whole array of responses to the material to be learned. Thus what we have

[3] H. R. Crosland, "A Qualitative Analysis of the Process of Forgetting," *Psychological Monographs*, Vol. XXIX, No. 130 (1921), p. 1. A useful summary and bibliography of related studies is also given here.

described, in learning, as the reduction of the cue, follows similar lines of dissociation and analysis. Our account of the relatively simple events involved in code learning may have given the impression that all learning is in terms of such initially limited cues as were there described. Such an impression may be corrected by citing here a more detailed account of "subjective events" in an act of learning.

It is cited by Crosland as a typical report such as was given by his more or less expert introspective observers. In this particular case the observer was shown a picture cut from the comic section of a newspaper. He was allowed thirty seconds in which to "learn the material." At the end of the half minute he was required first to recall "and then give as complete and as detailed an introspective description as possible of the procedure employed in learning." The introspective account of what occurred during these thirty seconds is as follows:

> Then the experimenter presented the material—my attention, as manifested in my visual line of regard, was immediately attracted to the lettering of the words "Rubes de Gink," in order from left to right, and the word "Gink" stood out most clearly, and I experienced a feeling of familiarity which consisted of a kinæsthesis of a slight relaxation all over my body and a passive, effortless, actual pronunciation of the words "Rubes de Gink." These words I repeated several times, and my visual fixation held on these words, as shown on the card material, for quite a while. Finally, in auditory-vocal-motor imagery, I said to myself this: "Yes, he [the experimenter] meant this experiment to be a verbal one, dealing with the letters in these words [Rubes de Gink]." Then my attention, my visual regard, and the clearness of my visual perception shifted, as though attracted, to the cartoon of the man on the extreme left of the material, and held on the humorous expression on this man's face [Son-in-law of the "Bringing-Up Father" cartoons]. Unpleasantness began to come to me as I continued to watch his face, which all the while became much more clear and durable than the rest of the picture. Then I experienced the eye-kinæsthesis of my regard shifting to the second picture from the left of the four characters, and at that moment, I had also the kinæsthesis in my eyes of staring at the picture. The picture was that of the elder woman [Mother of the "Bringing-Up Father" cartoons]; I watched her face, and then there interposed itself in the experience the visual image of

the man's picture [Son-in-law's] at which I had first looked; my fixation shifted to the latter's picture again, and then, by alternately shifting my gaze from one to the other, with consequent alternations in the clearness relations of my visual perceptions, I compared the two pictures; finally, my attention was fixed on Mother's picture—I noted her big hat—my visual perception then was accompanied by vocal-motor-auditory images of words in describing her. My visual perceptual regard and my eye-fixation shifted to the detail of her right ear where I visually perceived the diamond hanging;—in vocal-motor-auditory imagery, these words came to me, "diamond is shining—." My regard shifted to the third picture, that of the young woman [Daughter]; I stared at her face which was exceedingly clear, and this clearness of my visual perception persisted for a long time. My fixation and my perception shifted to the flowers she wore, and, in vocal-motor-auditory images, I said to myself, "they are roses"; thereupon, my fixation shifted to her face, then to her head, and to her hair arranged in a dome-like fashion, and to her curls. Then, somewhat suddenly, my attention was attracted to the funny, humorous expression on the face of the character number four [Father], especially to his winking left eye, this latter feature standing out prominently in clearness—I was experiencing pleasantness—and the other details of the picture were very vague and obscure.

As we have seen, an observer "undertakes to recall learned and retained materials in a manner which is strikingly similar to the procedure he employed in learning them." We may suppose that this "procedure of recall" also undergoes the various processes of dissociation, analysis, condensation, displacement, and so on, so characteristic of the content that is reproduced. In a single presentation, all these events are contextual cues to reproduction. We may, therefore, suppose that the changes in the reproduced content are in part if not wholly dependent on the loss of these cues, which when they first occurred were responses to the presented materials.

THE LAW OF CENTRAL TENDENCY

Many observers have reported the tendency for observed items to be "shifted," in memory, toward the average or type of the general group to which they belong. Small, faint, and light objects are thus likely to be exaggerated in report, while large,

bright, and heavy objects will be underestimated. Even in an experimental series of such objects, repeatedly encountered at protracted sittings, the extremes tend to be deflected toward the central tendency, when they are described or reproduced. That the tendency is relative to the particular series has been shown by shifting, in a new series, to a higher or lower region in the absolute scale. Thereupon the new series discloses the same central tendency of report. Magnitudes which in one series are underestimated are in another series overestimated, depending on their relative position in respective series.

Thus, when arm movements ranging up to 75 millimeters in extent are "reproduced," those longer than 50 millimeters are made too short; those less than this are made too long; movements of about this length (50 millimeters) show no such constant error in either direction. Iu such a series 50 millimeters is thus an "indifference magnitude." But if the movements range in extent up to 150 millimeters, both 50 millimeters and 75 millimeters extents are now overestimated; those of about 100 millimeters are "reproduced" without constant error; only movements longer than 100 millimeters are now underestimated. In such a series, therefore, 100 millimeters is the "indifference magnitude." Figure 25 shows the way in which the line of "indifference magnitudes," separating positive from negative constant errors, tends to rise as the range of magnitudes presented in respective series is extended.

Results consistent with this "law of central tendency" are found in the reproduction and estimation or identification, after one presentation, of many different varieties of material. These include, for example, empty time intervals, lifted weights, the length and area of visual objects, the size of angles, the extent, duration and force of movement, brightness intensities, and the intelligence of school children. It is not merely a law of memory but primarily a law of perception, an indication of the potency of partial clues. It is the general law of habit and adaptation.

A group of varying and diverse movements, directed toward a given end, gravitates toward an average performance which will economize effort and yet accomplish the end of activity.

This is motor automatism. But just so also our perceptual judgments are deflected toward an average estimate. The hunter who mistakes the clump of stubble for a rabbit is a familiar example. He is not engaged in an experiment on sensible discrimination, any more than the ordinary reader is

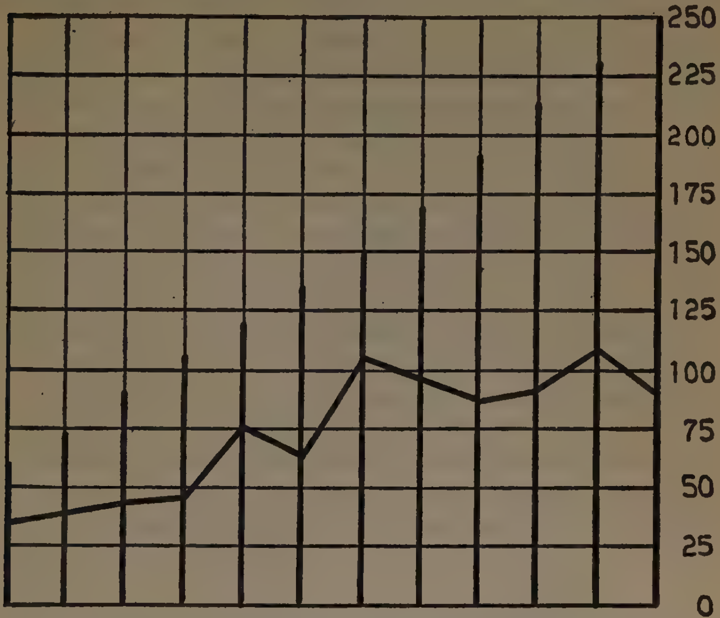


FIG. 25.—SHOWING THE RISE OF THE INDIFFERENCE MAGNITUDE WITH THE EXTENSION OF THE SERIES LIMITS, IN THE REPRODUCTION OF EXTENT OF ARM MOVEMENT.

Heavy vertical lines show the series limits. The curve shows the rising indifference magnitudes for the extending series. From H. L. Hollingworth, "Inaccuracy of Movement," *Archives of Psychology*, No. 13 (1909).

engaged in proof reading; hence small differences are disregarded, not reported, do not become conscious. The hunter is "set for rabbits" and anything which roughly approximates the form of a small animal is adequate as a cue to provoke the "rabbit" report.

So in ordinary life we are not concerned with small differences. We are more occupied with averages, types, central

tendencies, classes, and general resemblances. It is this fact which enables even a crude counterfeit to pass undetected. Each impression leaves a mental set (acquires instigative potency) which tends more or less to assimilate a succeeding impression, just as the "set for rabbits" tends to assimilate the clump of stubble. Any stimulus not *too* different, is likely to appear identical, even though directed and practiced scrutiny might make the discrepancy apparent.

In the case of magnitudes encountered in groups and series, those at either extreme will thus tend to appear more nearly like the central or average magnitude than when they occur alone or out of such a series. For a certain range above and below this center there will be a region of indifference. This region represents the range of magnitudes any one of which satisfies the general set induced by the series as a whole, linked most effectively to the modal or average magnitude. They can be roughly substituted for each other without modifying the response, without evoking a variant report.

This region is, therefore, a measure of the degree of similarity between present cue and past detail which permits the cue in question to function redintegratively. From the point of view of a given response or report, this is a measure of the change in magnitude required to constitute a "sensible difference." Magnitudes lying outside this region lack adequate instigative potency for the consequent in question; they have their own consequents. The fact that this region varies somewhat with the nature of the consequent, makes the determination of a "sensible difference" and the study of "sensible discrimination" difficult. For the measured region of indifference will vary somewhat with the mode of report. Differences that are "sensible" for affective response may not be so for verbal report. Any description of a sensible difference must, therefore, be given in terms of a specified mode of report, for the potency of a cue can be indicated only in terms of a given consequent.

Stated in rather more old-fashioned terms, the magnitudes within this region comprise a background or level. Only magnitudes which "emerge from" this level, or stand out as "fig-

ures" on this background, will be perceptually discriminated and independently identified by their own peculiar reports. It is to this general fact that the useful term "class" is applied. A class of objects or events is a fairly limited number, any one of which, for the purpose of a given consequent, may be substituted for another. Membership in such a class is what constitutes the "identity" of objects.

The redintegrative basis of this phenomenon is obvious. The mean of a natural series is also likely to be its mode—the degree or magnitude most often encountered. To it as a total context a characteristic response or report is soon attached. Any new item with features of special or general resemblance is likely to touch off, in redintegrative fashion, this ready report. We are thus "set" or "ready" for the mean or the typical, and counterfeits readily pass muster. New and in some respects different items are "assimilated" to this type item, the central tendency of the group. The new item is thus in a sense "pre-judged." Even racial prejudices originate in this general redintegrative fashion. So humanly set are we to find the type that variations are easily ignored, overlooked, or forgotten.

This law of central tendency, which we have encountered first in connection with verbal and imaginal memory, is significant in other fields as well. It pervades even our simple sensory discriminations, and our judgments of magnitude, degree, and worth. It is the rudimentary process out of which grow the more abstract events, such as conception and generalization. On its simple redintegrative basis concrete and individual words, images, and other symbols, come to function for series, groups, and classes, and are thus freighted with general or universal significance. In this way, for example, words which begin as "proper names" become generalized into "common nouns," and "percepts" become "concepts." Individual images and other particular symbols become "general ideas"; that is, they have general reference. They function for the "common elements" of diverse past contexts. But "general ideas," descriptively considered, are always specific, concrete, and particular events.

CHAPTER XV

IMAGINATION, DREAM, AND INVENTION

THE TERM "IMAGINATION"

Along with memory, the concept of imagination has been very loosely used in the history of psychology. We can perhaps best proceed by noting some of these heterogeneous usages before attempting a direct account of what imagination descriptively involves. The word is often applied to diverse situations which have at most but few common features. With a few such situations in mind, we may be able to discern the nature of such common features as are characteristic of imagination.

1. Thus imagination is used to indicate the mere presence of mental imagery. Children are often said to have "vivid imagination" in the sense that their mental images in the various sensory modes are lively and realistic. Some observations suggest that "veridical" or "eidetic" images are common in youth. By this is meant that they so faithfully duplicate the qualities and relations of their stimuli or originals as often to be mistaken for them.

2. In a somewhat related sense, imagination is used to denote any mode of symbolizing or representing past or absent events. It seems indeed to have been generally believed by many that all "ideas" are images. Hence to "think of" or to "mean" a past or absent event was to have a present *image* of it. In fact, early psychologists seem to have conceived the realm of mind to be essentially a flow or stream of mental imagery. We have seen, however, the manifest error of this account of thinking. Innumerable varieties of items may constitute "ideas." Any detail, functioning for an antecedent

complexity, may be called an idea of that complexity, a symbol for it. The term imagination, with its inherent suggestion of the image, is, therefore, inappropriate to designate the manifold ways in which the past or absent may be represented. The very use of the word suggests a wrong description of the nature of symbolization and meaning.

3. Imagination is also much used in a way to contrast it with memory. Memory, with its "backward reference," is in this case considered as a mode of representing the past, either by way of *presenting again* or by way of *standing for*. It is important to keep in mind these two uses of the term "represent." Thus a crayon drawing may represent a prisoner at the bar, by imitating him. But the defendant's lawyer also represents him, in a different sense, by acting for him. Traditional psychology has often supposed that all representation is of the former kind, overlooking the important rôle of representation by surrogate activity. In the sense here considered, to imagination there is ascribed a "forward reference," a prospectiveness, as distinguished from the reminiscent character of memory. In imagination as thus conceived, events are supposed to be lived through in advance of their occurrence, to be anticipated and foreseen. The approximate correctness of this usage will be seen in later sections.

4. Again, imagination is used to indicate any "uncontrolled" play of symbols, in which each in turn serves as the cue for the next. No persisting, determining cue is present to give direction to the train of ideas, or to exercise selection among them. Thus an image *A* is given. It contains a detail *b*. This detail is an adequate cue for another image *B*. This contains an item *c* which instigates the image *C*, and so on *ad libitum*. Or, as in the so-called "free association" of verbal elements, one word, such as "fur," leads to the word "cat," which is an appropriate response to a larger context of which the word "fur" is a detail or name. The word "cat," thus instigated, leads in turn, and in the same way, to "mouse." Then come "trap," "hunt," "Indian," "tribe," "family," "father," "priest," "Pope," "Rome," and so on. Ordinary reverie or daydreaming of the unmotivated sort is a rich exam-

ple of this type of "free imagination," as is much of dream life also.

5. Imagination is also used as the name for extreme subjective events, unconfirmed by the reports of other observers. Thus the neurotic's fear is said to exist "only in his imagination." Number forms, symæsthesias, æsthetic feelings, and epileptic auræ would on this basis be imaginary, though not necessarily imaginal. So would be also the migraine figure, various hallucinations, and the surprising heaviness of the smaller objects in the size-weight illusion.

6. Finally, but by no means exhaustively, the word "imagination" is applied to those cases in which prompt and animated responses follow upon even subtle cues. Thus young children and poets are said to have "facile imagination" because they play upon "the slightest resemblances" of objects. To children, any object which they can bestride, at once "becomes a horse." A broomstick, a chair arm, a sawbuck will serve this end, equally well with rocking-horses, wagons, large dogs, or father's back. Any small object to which toy dresses can be attached (a clothespin, a corncob) "serves as" a doll. Monsters and fairy queens are seen in cloud, in flame, and in inkblots. Since such slight cues serve to instigate feelings, names, and activities appropriate to more imposing contexts, children are said to be "highly imaginative." But in this case the term has no necessary reference to mental imagery. The word imagination is by no means ordinarily limited to these six situations, but they suffice to illustrate the diversities of its application.

THE PATTERNS OF IMAGINATION

The essential feature of imagination is not the presence nor the vividness of mental imagery, although images may sometimes play an important rôle in such activity. Imagination does, however, always involve the use of symbols, and in a particular way which distinguishes this activity from memory. In reciting a poem, learned by heart, each word, as it occurs, is both the consequent of preceding words and the cue for

words which follow. Such connections also characterize imagination. Such words, however, are themselves symbolic, and such an act of recitation, therefore, is a play of symbols. While this is not always the case with memory, it is an essential feature of imagination.

But the essential thing in memory, as in reciting a poem, is that the total organization of the items constitutes a pattern. The words stand in certain mutual relations, not only to adjacent members of the series, but also to more remote members. This pattern of relations was, moreover, first encountered in previous contexts, on such earlier occasions as the period of training. Memory consists not only in the instigation of the separate items, but also in a duplication of the previously established total pattern or structure. The criterion of memory is, therefore, *the pattern of an earlier antecedent.*

In imagination, on the other hand, the criterion is not an earlier but a present or subsequent event. Symbols are also manipulated (as often also in memory). And as symbols they originate in past contexts; not from a single context, however, but from many. And these symbols occur in, or are given, a pattern of organization which such elements may never before have assumed. The criterion or control of the pattern is its *potency in evoking a present or a deferred consequent,* a feeling of pleasure, a satisfaction, the resolution of a state of doubt, or the removal of a difficulty.

Thus I *remember* a melody when familiar notes occur in a pattern identical with an earlier one. But I *imagine* a melody when familiar notes are *represented* in a pattern of such a sort that I or others am pleased or æsthetically satisfied. I *remember* a series of numbers in so far as familiar digits now recited conform to the pattern presented in the memory span test, and discoverable on a printed sheet on file in the laboratory. But I *imagine* a series of numbers such as this when the pattern which I give to the familiar and very limited available number of digits, will serve as a new standard for a subsequent memory span test on another person.

Imagination is, therefore, invention, and invention consists in the arrangement of *old materials* in new *modes* of organiza-

tion. In the invention of a melody the items manipulated may be *any symbols* for tones, as graphic circles on printed scales, auditory imagery of sounds, or kinæsthetic patterns of strain and tension associated with the vocal organs. Any material is acceptable which may be given relations and structural organization that may be later *realized* in an actual tonal series, with specified criteria of adequacy.

But if my melody is composed by the overt production of tones, as in striking the keyboard in a direct and experimental way, I am not imagining. Instead, I am exploring, adventuring. In adventure, materials are directly manipulated, in the search for a pattern of relationship. Imagination is also exploratory and tentative, but the materials manipulated are at least one stage removed from the originals which they, as symbols, represent.

Thus the army officer, manipulating the colored pins in his wall map, may either be imagining or remembering. The distinction is not to be found in the materials with which he works, but in the stimuli and the consequents of his activity. If he is remembering, the stimulus to his activity is some symbol for a past battle and a system of maneuvers which he now seeks to *review*. If he is imagining, the stimulus to his activity is some symbol either for an immediate consequent (as assurance, satisfaction, pride) or for a deferred consequent (such as victory, safety, glory). These consequents either come at once or will later result, when the pattern now imposed upon the symbols (colored pins, spatial relations) is transferred to the situation which these symbols represent. The difference between memory and imagination is, therefore, not to be found in the materials or the processes of the activity, but in the stimulus to and the consequent of this activity.

SUBTLETY OF CUE AND IMAGINATIVE FERTILITY

The imaginative are those with a ready fund of symbols, originating in past contexts, but relatively free from dominating relations. The unimaginative man is cramped by past patterns. He thinks and acts, speaks and feels, as he has been

systematically trained. He is a prey to the conventions of a limited history. He fails to originate; his steps are predictable by others with similar limitations. His achievements, therefore, tend faithfully to follow the exemplary models of his teachers.

For such an individual small and subtle cues scarcely suffice. When they function, they lead singly and solidly toward the set consequents of their former contexts. Other subtle cues, however "available," are ignored or overlooked. Because his required cues are gross and the patterns from which they have been derived are few, the unimaginative man is "literal minded." Figures of speech weigh heavily on his conscience, and he does not readily leap over them. Instead, he becomes enmeshed in their "literal" character.

Lack of imagination, or weak imagination, results partly from this necessity for gross cues, which must often approximate the total situation which they represent. It results also from paucity of established patterns. Lack of originality then commonly implies poverty of previous learning. The two influences are closely connected. The very necessity for gross cues means not only that learning moves slowly and results in meager experience. It means also that few contexts can be represented by a given effective cue and thus brought to bear upon a given moment. For the smaller and subtler the detail, the greater the variety of situations in which it may participate and for which it may later function. The grosser the cue and the nearer it must approximate its total original context, the fewer the contexts thus represented.

A rough illustration of a rather artificial sort may best serve to make this situation clearer. Consider the contexts *ABCDE*, *ABCDF*, *ABCHJ*, *ABKLM*, *AMNOP*, and the constituent details (letters) which as parts might function symbolically for them. If so slight a cue as *A* is adequate, it may function for any or all five of these contexts. The system (individual) to whom *A* occurs, as effective antecedent, thus has a rich array of consequents, or varied combinations, which may be evoked. For we have seen that consequents simultaneously evoked may combine according to their various

compatibilities. The resultant of such combination is thus likely to be novelty, originality, initiative.

If, however, so subtle a cue as *A* alone is inadequate, some larger constellation of details is required for any consequent to occur. Thus if *ABC* is required, only three; and if *ABCD* is required, only two, of the past contexts will be represented. The completely unimaginative or literal-minded individual will require the whole of some one pattern, and his repertoire of response will be limited to the duplication of some previous action. Novelty, originality, will be missing.

The "fertile" mind is thus one in which variety of response occurs on the basis of a multiplicity of effective cues. These thus represent or enable the contribution of a "rich experience," that is, of ample previous learning. This is why genius is so often defined, as for example by William James, as the capacity to see similarities in a crowd of diversities. For the potency of so subtle a cue as *A*, alone, is what is involved in discerning similarities in contexts whose most obvious features are their differences, rather than their resemblances.

The fertile, original, spontaneous, inventive individual, whether in science, art, industry, or action, is thus the imaginative one, the ready learner. Such individuals as Goethe, Darwin, Burke, Marie Curie, Newton, Pasteur, George Eliot, Spencer, Shakespeare, are characterized first of all by this "creative imagination." They responded to obscure similarities, to subtle cues, where lesser lights required grosser stimuli and saw only manifest differences. Their originality was not the spontaneous generation of important consequents out of the void: it was instead the capacity, through subtle cues, to profit from an exceptional wealth and range of previous observation.

Such wealth of previous learning may result from a native and immediate propensity for it; or it may perhaps also be achieved by extreme diligence and patient industry. That we are unable to "account for" such exceptionalities is sadly true. They occur in nature, and we seek to render them intelligible by the use of such names as heredity, variation, genius, intelligence, and idiosyncrasy. Of course, we no more

truly explain them thus than we do the presence of atoms, the nature of space, the existence of time. As psychologists we can describe such individual deviates, classify and measure them, learn to diagnose them earlier, seek to correlate their presence with other observable occurrences, and thereby discover perhaps the basis of our own limitations.

PLAYFUL AND PRODUCTIVE IMAGINATION

The motive for imagination may be either a present pleasure or a symbol for future gain. We have not yet exhibited the nature of a motive; this is a topic which will concern us directly in the following chapter. Until then, a motive may be briefly defined as a relatively persisting stimulus, giving direction to the play of more transient cues. There is some "reason why" imagination occurs, rather than sleep, for example, or memory or adventure. This reason or motive is the stimulus to the activity as a whole.

In playful or divertive imagining the process is kept going for the immediate pleasure which it yields. Thus children playfully draw lines, build structures, babble words, in varying though limited patterns. The novelties that result bring their own satisfaction; they are curious forms, intriguing sounds, suggesting mildly perilous episodes. Or, in somewhat more coherent playfulness, the crude stimuli serve to invite stirring consequents. The clothespin falls, and requires a nurse; it breaks, and forthwith needs a doctor. The cloud or smoke suggests "giant"; "An' now let's go an' find Jack-the-Giant-Killer!"

So also the poet often sings for his own joy or resolves his sorrow by making it articulate. The "chess fiend" plays for momentary excitement or amusement; the philosopher speculates to assure himself of his own astuteness or because he "loves the game." In the life of phantasy, obstacles are freely brushed away. Successes and personal satisfactions are dreamed; they flow from fancied acts and represented situations. Our "imaginary companions" do us no wrong; the fancied audience flatters us. Even our "imaginary grievances"

and calamities serve to give us a momentary importance which the acts of memory commonly deny us.

Imagination, in its relative freedom from particular past patterns, and in its derivation from many, is a "flight from reality." It is even suggested that at least some insane delusions are constructed and cherished for the vicarious satisfactions derived from them. It is at least true that for most of us imagination in its playful aspects contributes a solace that memory more grudgingly affords.

It is important to contrast such playful imagination with that motivated not by a present glow of feeling, but, instead, by some representation or symbol of a future gain. Imagination of the latter type is planful, rather than playful. The army officer, at his wall map, fancies now this and now that attack and maneuver. He does this not for the immediate "fun of the thing" but in order to prepare for prospective emergency. The inventor struggles through countless sketches, outlines, and equations, in order that to-morrow or next year a valuable remedy, tool, or substance may be fabricated.

Ehrlich, the imaginative investigator, was not merely adventuring or blundering through the 605 formulas that preceded the epoch-making production of salvarsan. Each of these formulas was an imaginative pattern, a symbolic arrangement of old materials in novel configurations. The motive for the series was some representation of, some symbol for, or picture of, just those therapeutic uses to which the medicinal agent is now put.

THE CREATIVE IMAGINATION AT WORK

It is appropriate here to give concrete illustrations of the productive imagination and the factors on which it depends. We may use, on the one hand, the homely example of a game of billiards and, on the other, describe the production of one of the world's most famous doctor's theses, that of Marie Curie.

A child, playing with billiard balls, shoves them about "aimlessly," enjoying each momentary roll and bump. He is highly pleased when the balls do "funny things." But the expert billiard player represents a more planful picture. Each

"play" issues from a problem to be solved. Possible "ways out" are tentatively rehearsed, tried out in gesture, through eye movement, verbally, or in visual imagery. Various resources are thus summoned "in fancy." Each is a familiar shot or a trick executed or observed in the past, and each is now represented by some present symbol—a name, a tentative arm movement, a mental picture. Even the desired movement and the final position of the balls is symbolically indicated; the eyes fix definite spots on the table, the head nods, now here, now there. The fertile, resourceful player is one who has a large array of "tricks" at his disposal, from past learning, and who gets ready "suggestions" from slight relational features of the present layout. Of course, there are various other determinants of skill in billiards, such as steadiness, visual-manual coördination, zeal. But these are readily enough distinguished from the "insight" of the player, which is his imagination.

A vivid picture of the productive imagination at work is given in Marie Curie's account[1] of her life and work with her husband. First we see the young Polish girl, struggling against political, economic, and conventional odds, to secure an education, a background of contexts in terms of which effective cues may later work. She studies, widely—with little guidance and few sources—music, literature, languages, sociology, mathematics, chemistry, physics. While tutoring a family of children for a living, she secures permission to work evenings, on her own initiative, in a municipal laboratory.

"I tried out various experiments described in treatises on physics and chemistry. . . . At times I would be encouraged . . . at others in the deepest despair. . . . Though I was taught that the way of progress is neither swift nor easy, this first trial confirmed in me the taste for experimental research."

Then with difficulty she succeeds in beginning student life in Paris, first working alone to establish adequate preparation (past contexts) for regular courses. "The room I lived in was a garret, very cold in winter. . . . In the same room I prepared my meals . . . often reduced to bread, with a cup of

[1] Marie Curie, *Pierre Curie* (Macmillan Company, 1926).

chocolate, eggs or fruit. I had no help . . . and carried the little coal I used up the six flights. . . . All my mind was centered on my studies."

Next she enters the Sorbonne courses, beginning laboratory work for a thesis in physics. She marries the young physicist, Pierre Curie, impecunious but devoted to research. They work together, pooling their knowledge and insight, and producing important papers on crystals, magnetism, electricity. With the accumulation of learning, new problems intrigue her. Strange rays are reported by Becquerel, from salts of uranium. "I resolved to undertake the special study of it."

Acquired learning gives great significance to slight features of this new phenomenon, just as her husband was led to his striking results with crystals by noting subtle resemblances (spatial symmetry) in animals, plants, and other objects as well as crystals.

First measurements are taken, the joint knowledge of both workers being pooled in devising adequate instruments. A subtle resemblance of uranium and thorium is noted. It leads to discovery of other substances also thus characterized. Does their radioactivity depend on their atomic properties? Here is at once an hypothesis, a symbolized but unverified conclusion. It is at once established. But the activities exceed those which these two substances will explain.

At once another symbolic solution is made.

"There must be, I thought, some unknown substance, very active, in these minerals. I urged that we search at once for this hypothetical substance, thinking that with joint efforts a result would be quickly reached." Then began a search for cheap substances containing this "hypothetical" ingredient, of which it was known "only that it emits rays." Polonium is at once discovered and extracted from pitchblende.

Further effort is made to *actualize* what is yet only *symbolized*, and in another six months the investigators were able to "announce the discovery of this new and now famous element to which we gave the name of radium."

Then, still working with meager equipment, in a leaky shed, they set about the difficult task of isolating the astonish-

ing substance. In four years this was accomplished, and a determination made of its atomic weight and chemical status. A year later "I finished my doctor's thesis and obtained the degree. At the end of the same year the Nobel prize was awarded jointly to Becquerel, my husband and me for the discovery of radioactivity and new radioactive elements." It is on such diligence that "scientific imagination" rests.

IMAGINATION IN DREAMS

Whether the dreams of sleep and semiwakefulness are playful or productive is still a doubtful matter. In some respects they seem to constitute the acme of imaginative freedom. Cues and consequents run a riotous course. Often the stimuli can be identified, and the dream seems to be a faint-hearted perceptual interpretation of these cues. The contexts determining this interpretation may, however, be remote from those we note and employ upon waking.

In the supine position, pressure is removed from the soles and from the arches and muscles of the foot: we are flying or falling. Outside noises die down and the hitherto obscure ticking of the clock emerges from its background: soldiers are marching and drums beating. A rooster crows in early morning: it is Gabriel's trump and the heavens roll back as a scroll.

Such trivial cues instigate reports by way of imagery, feeling and emotion, bodily postures, verbal equivalents. But the details are such as have been present in manifold contexts. No guiding or directing cue persists. Hence the consequents are that bizarre array of which the dream consists. Or some interpretations come more slowly than others, and the dream is a series of "logically absurd" stages. Or successive interpretations represent more and more closely approximate valid accounts, until as the dreamer fully awakes the perceptual interpretation becomes one with which others would agree. If this is all that dreams are made of, they are "the height of imagination." Even immediate satisfaction fails to guide them, although the dreamer does sometimes find himself lin-

gering over or rehearsing dream episodes of special interest or vividness.

Some who have made special dream investigations insist, indeed, that such processes are strongly motivated, though by obscure and unarticulated (unconscious) stimuli. The dreams of young children, it is asserted, commonly constitute symbolic completion of antecedents (desires, cravings, wishes) of the preceding day. The child, denied a third helping of his favorite dessert, dreams that he is floating on a sea of it. In the dream, that is, he has the forbidden dessert in abundance. Even here of course the completion is symbolic—it is only an image of the object that he has. The cue is thus conceived to be still persisting and dictating the interpretation of more transient stimuli.

Others find dreams in which it appears that daytime worries, problems, or emergencies are still being worked out. In waking life they would be solved symbolically, through words, perhaps, or drawings, or the kinæsthesis of gesture, posture, and eye movement. Now these symbols fail and those available are the imagery qualities less used by adults in waking life. Thus described, a dream is the pictorial and figurative solution of a personal dilemma.

This is supposed to be especially the case with dilemmas in fields socially tabooed from free discussion or gratification, so that most people do not even acquire an adequate vocabulary for them. Among these the dilemmas of fear, sex, and pride are said to figure prominently. For sex topics, for example, all but the exceptional are limited to vulgar vocabulary of slang. But imagery for such topics is free, and even the vulgar vocabulary is largely based on analogy and metaphor drawn from other objects. These objects it is said, appear in dream imagery, freighted with the derived meanings of their names.

THE PSYCHOLOGY OF DROWSINESS

The study of drowsiness episodes and experiences throws a double light on mental activity. The mental sequences of

drowsy periods point in one direction to the processes which in the dream are relatively unconfined. In the other direction they reveal the way in which these very processes are more ordered and regulated in dignified waking thought. In noting, therefore, the course of events in drowsiness, we may usefully prepare the way for a description of more deliberate acts of reasoning and reflection. The first fact of importance is the intimation that in all these dreamy occurrences there is, in addition to the instigation of transient cues, the more enduring direction of persistent cues which we have here called cravings, problems, dilemmas. In the chapter on reasoning we shall see the high importance of these motives or determining tendencies, and inquire into their nature.

In drowsiness, as in childhood, images occur with a freedom and vividness to which the educated adult, at least, has become unaccustomed. There is even an indication that, if imagery is employed in daily life, the modes preferred for daytime use recede in drowsiness. At least, those imagery modes of least frequency and richness in waking life often appear with emphasis in drowsy hours. The "motor minded" and the "verbalist" may find in this period, between waking and sleeping, visual images of a quality and liveliness not afforded in full waking experience.

In drowsiness there is a rich fund of material suitable for symbolic use. Current sensory events, bodily posture and gesture, verbalization, mental imagery, and innumerable relations between all these, along with momentary feelings and emotions, are all available. Subtle cues seem especially effective but often lead to incongruity, or lead in spite of incongruity. Slight similarities easily suffice to permit one symbol to be substituted for another.

A "train of thought" begins, perhaps, concerning a recent conversation with another. At first the speaker is symbolized by active verbalization of his previous words. Soon this is supplanted by visual imagery of his person. This is replaced by auditory imagery of his words. Now his talk is represented only by some droning noise, conveniently originating in the local neighborhood. Thus the present whirr of machinery from

a nearby factory or the rumbling of the iron wheels of the Pullman car may serve as such symbols. But throughout, the attitudes and feelings evoked are determined by the past context, the recent conversation.

This fluidity of symbols, their easy substitution by equivalents, shows how shifting may be the symbolism of thought sequences. So nimbly does this shifting occur that an effort to "catch the thought" and describe its material readily results in clutching some bare event whose meaning is now gone. The meaning is now "carried" by some other subtle equivalent or synonym. Yet the "terminus" or conclusion of the process may be in all cases the same verbal verdict, and applicable with more or less fidelity to the original situation which this fluctuating symbolism represents.

It is as if our convenient army officer should now abandon his pins and wall map and stride about the floor with vehement speech and gesture; or sink into his chair and engage in rapid eye movements and bodily tensions; or recline on his couch and occupy himself with visual imagery. Throughout he might, however, have been engaged in the continuous solution of the same problem in tactics or strategy.

In full waking life such shifts, substitutions, and vicarious functioning are not the rule. One commonly stays by the vocabulary and language with which he begins. But occasionally even here, and in drowsiness as a rule, the vicarious substitution of one sign for another is conspicuous. All that is needed is that the *relations* of these signs, in whatever field, be adequate to represent the relations of the original objects or situation. In a sense then, in dream, in drowsiness, and in sober thought, the *fundaments* may perish, but the relations are shifted to other piers.

These are the features of drowsiness that throw light particularly on sober reflection—the effectiveness of a persisting and determining cue, and the substitution of one field of symbols for others. Various additional features suggest the development of the more bizarre effect of dreams. Thus, in drowsy speech, gesture, and imagery there is frequently a magnification or exaggeration of magnitudes and values.

This arises in part through the functioning of trivial cues for more impressive contexts.

Moreover, the verbal associations of drowsiness display superficial relationships. Slight resemblances often give rise to amusing confusions, and often to adequate literary figures. Lines of thought proceed with little interruption by collateral observation. They thus lead to exuberant conclusions which waking hours promptly reject. This relative and partial dissociation of sequences and contexts results in subsequent memory inadequacy, best shown in the extreme amnesia (forgetfulness) for dream episodes.

The mechanism of dream and drowsiness throughout is that we have found to be typical of imagination. It is the redintegrative potency of subtle cues which, because of their subtlety, are not limited by the constraint of particular past patterns, but function freely for many. But the patterns represented must be genuinely past contexts in the life of the system in which they are now represented. This is the reason why the individual who is highly imaginative in one field may not be equally fertile in others. For fertile imagination in a given field or with given materials implies abundant past learning in that field, and it is promoted by abundant learning in other fields as well.

THE QUANTITATIVE STUDY OF IMAGINATION

Since imagination involves the use of symbols as consequents as well as stimuli, it seems likely that the process is a distinctively human one. Many attempts have been made, with limited success, to apply methods of measurement to activities which are predominantly imaginal. The processes have, for the most part, been of a somewhat trivial sort; or, at least, the products were on a relatively low level of worth. The "higher reaches" of imagination, whether of the playful or of the planful sort, are so complex that quantitative study of them as wholes is difficult, to say nothing of the analysis out of them of the more definitely imaginative elements.

Relatively simple imaginative and inventive activities have

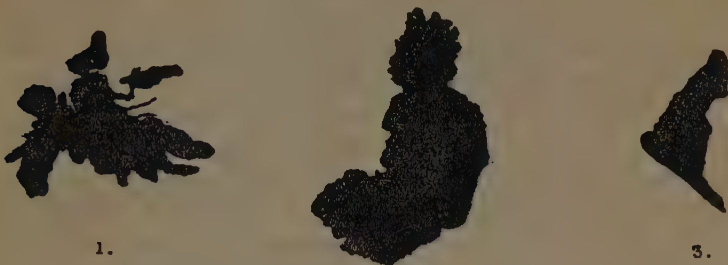
been studied both in children and in adults. The cues presented have been such details as ink blots, letters of the alphabet, incomplete sentences, mutilated paragraphs from which certain parts have been omitted, titles of possible stories. With these as cues the subjects are instructed to describe objects seen, to invent words, to complete partially presented themes or statements, or to compose stories and sentences. Records have been made of the character of these products, and qualitative classifications of them have been made. The speed of performance has been noted, the number and range of the responses indicated, and evaluations made in something like quantitative terms, of their variety and worth. Such measures have been correlated with numerous factors, such as age, sex, education, general mental ability, occupation, fatigue, and the like.

In the ink-blot experiment the subjects are presented with a standard series of such blots, photographed and printed uniformly. They are told to look each over in turn and then to report under some such instructions as: "Tell me what things you can see in each blot. Try them in different positions. Of course, these blots are not really intended to be pictures of anything, but I want to see whether your imagination will suggest pictures of things in them, just as you sometimes try to see what objects you can make out of clouds." Sometimes the time required for the first object is the measure used; often, instead, the number of objects suggested by a given blot or series has been considered; sometimes the position of the blot pattern is fixed and it is not to be turned about; sometimes only a few blots have been used, as four, for example; at other times series of as many as twenty have been employed. The different studies are not readily comparable because of these variations.

It is clear, in the first place, that this is by no means a process in which "imagery" is necessarily involved. The responses may be affective, perceptual, and often strictly verbal identifications. They vary greatly from individual to individual, both in number, speed, and qualitative features. Thus a number of adults, shown the same blot, reported: "A

lady seated on a couch," "a witch riding on a new moon across the sky," "a moose's head," "a woman, sitting on a bank of shrubs, waving a handkerchief," "a fir tree," "a dragon in the woods."[2]

When written responses are used, children from eight to fourteen years of age average from two to four responses a minute. Adults have given averages of a little over three in this time. Younger children have been found to give more responses, that is, to give identifying names to more blots in the series, than older children. The influences here are



1. 2. 3.

FIG. 26.—SPECIMEN CARDS FOR THE INK-BLOT EXPERIMENT.

complicated. Younger children appear to have greater "freedom" in the matter but a smaller fund of past context from which to draw. Adults differ in striking ways. Thus in one study in which ten blots were used, the "most imaginative" subject saw eighty-one objects, the "least imaginative" only twenty-seven. Some such responses or individuals show strong matter-of-fact dispositions; they tend to report with fidelity to particular past contexts. Others are more original and "constructive"; the response affords a present satisfaction rather than a faithful reproduction. When colored and white children have been compared in this process, no significant differences have been found.

The ink-blot test at least approximates the mode of playful

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[2] For bibliography and data on the ink-blot test see G. M. Whipple, *Manual of Mental and Physical Tests,* (Warwick and York, 1914,) Vol. II, Chap. XI.

imagination, in that any response that "pleases" the subject is acceptable. Quantitative studies of "linguistic invention," as in the case of word building, illustrate somewhat better the planful imagination, since the products, to be adequate, must not merely be "pleasing," but must be serviceable as meaningful words in a specified language. In this test, in the form we may conveniently choose as our example, the subject is presented with a limited number of letter cues, as *A E I R L P*.

From these letters the subject proceeds to "make as many words" as he can. The rules commonly given are such as "You may use any number of the letters, from one to six, but no letter may be used twice in the same word, and no letters other than these six are to be used." The quantitative score is the number of acceptable words made in a specified time (commonly written in five or three minutes). According to the standard in common use[3] there are seventy-six possible words in the case of the letters *A E I R L P*. The following table, from Whipple, following Anderson and Pyle, shows the quantitative changes in this case with age, in the case of boys and girls, when five minutes are allowed for the letters *A E I R L P*:

TABLE XII

AGE NORMS IN WORD BUILDING

	Ages										
	8	9	10	11	12	13	14	15	16	17	Adults
Boys											
Averages	5.5	7.3	8.3	10.6	11.5	12.6	13.9	16.2	17.0	19.3	21.8
Cases ..	39	88	102	112	130	140	111	87	63	52	30
Girls											
Averages	6.5	7.7	10.2	11.5	13.3	14.7	16.2	17.4	17.7	18.0	21.4
Cases ..	41	97	124	114	138	94	121	98	94	71	45

If these figures are representative of the general population we may conclude that this mode of inventiveness increases, in

[3] See Whipple, *ibid.*, for standards, instructions, bibliography, and review of previous investigations.

the score here used, with age, approximately trebling in the ten years from eight to seventeen. In such a case we are not able to separate individual differences in the potency of subtle cues from the influence of the accumulation of acquired patterns with advancing experience. But if we have a group of individuals of the same age, and of reasonable opportunity for past learning to be equalized, we find that there are

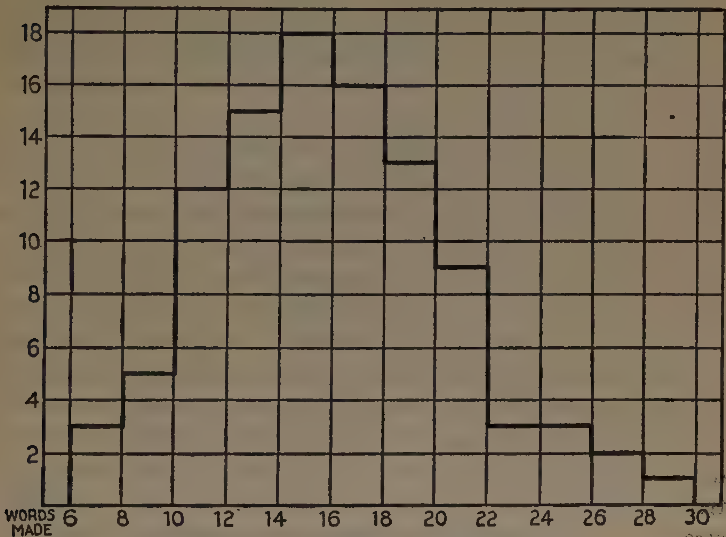

FIG. 27.—PERCENTAGES OF COLLEGE FRESHMEN MAKING VARIOUS SCORES IN THE WORD BUILDING TEST.

On the base line are indicated the number of words made, while the vertical scale represents the number of individuals.

very striking individual differences which must reflect "ability to learn" rather than mere accumulation of past contexts.

Thus the graph above is a surface of frequency, showing the distribution and range of ability in the *A E I R L P* word construction process among college freshmen, the time allowed being in this case three minutes instead of five, as in the case of the children. The base line indicates the range of words constructed, the individual numbers varying from six to thirty. On the vertical axis is shown the number of college

freshmen, of a group of one hundred, who made these various scores. The typical or modal performance is the construction of fifteen words, five per minute during the three minutes allowed. But even highly selected college students, all of whom have confronted and satisfactorily mastered those standardized verbal contexts represented by most of the material of elementary, secondary, and preparatory school curriculums, differ widely from one another. The best score among these one hundred students is twice as good as the typical performance, and the poorest score is less than half as good. The best student constructs five times as many words as the poorest.

It is clear, or at least likely, that such differences as this reflect constitutional variations in imaginative ability, at least in this particular field. There is reason to suppose that in more complex constructive processes the range of native capacity will be even more extended. For it is a general rule that in a given species the individual members are more variable in their more complex traits than in their simpler ones.

The ink-blot test and the word-building test thus serve as approximate illustrations of the playful and the planful activities of imagination. Not only do they exhibit the striking differences in such processes in individuals; they also illustrate the particular features and influences which we have stressed as conspicuous in imaginative activity. There are manifest differences in the subtlety of the details which have adequate instigative potency. There are equally definite variations in the readiness or promptness with which such cues function for their past contexts. There are varying numbers of such past contexts which are on a given occasion represented by such cues as operate. The result of such differences is shown in the freedom with which playful imagination moves, and in the success with which inventive or constructive imagination meets the conditions of the criterion or motive which directs it.

Learning, memory, and imagination are thus seen not to be in any sense discrete powers or faculties. They are only emphases of one or other aspect of the one fundamental redin-

tegrative mode of sequence, or situations in which one or another of these aspects is conspicuous or of special concern. We shall see, as we proceed, that much the same thing is true of reasoning, purpose, and voluntary action, except that certain complexities are in these cases more prominent. Indeed, it is now apparent that what we have been calling imagination begins to exhibit these complexities.

For constructive imagination is a reasoning process. It is directed by a motive or criterion, by a problem to be solved. It is an activity involving purposiveness and voluntary selection, although these are not the features that have been most emphasized in this chapter. We have more than once postponed the description of motives and their operation, in the foregoing chapters. Motivation will be so important a feature of the chapters to come that we must now address ourselves directly to this topic.

CHAPTER XVI

MOTIVATION: THE DYNAMICS OF MENTAL ACTIVITY

MENTAL AND PHYSICAL PROCESSES: A REVIEW

To whatever topic we have turned in the foregoing chapters, we have found the essential thing about mind to be its activity. Mental facts are processes, sequences, dynamic events in which cue leads to consequent. Mental processes are, therefore, essentially impulsive and every stimulus is an urge. If we abide by the *materials* of such processes, we find nothing deserving the term mental. We find only neutral natural items, the attributes, qualities, relations, structures, and situations which, thus described, suggest an arrested and static picture. They are neither mental nor physical, but comprise a continuum of data, with their varying uniformities of report. Distinctions in terms of substance or material have often been attempted and many still cling to that quaint description of things as made either of "conscious stuff" or of "the stuff of matter." Such distinctions, except when used for dramatic or figurative purposes, lead only into metaphysical muddles.

Nature is a complex of occurrences, changes, sequences. At the one extreme these sequences are completely duplicative: the total antecedent (or one of its class) is required as the forerunner of a given result. Such sequences we have called physical. At the other extreme are those modes of sequence in which a reduced cue is effective: partial details instigate consequents appropriate to larger previous complexities. Such sequences we have called mental or psychological. Since, moreover, various degrees of cue reduction are found, we have been unable to draw any sharp line dividing these two extremes. Even the suggested distinction between physical

and mental sequences is thus a matter of more or less, as is also that between objective (uniformly reported) and subjective (discrepantly reported) events. So much by way of general reminder of what we have already repeatedly felt impelled to reaffirm.

The important fact is that both the world of physics and that of psychology are dynamic. Things happen, one thing becomes another, antecedents lead to consequents. This observation that "everything flows" and the insistence upon it as the fundamental fact of nature gave Heraclitus his place in the history of science.

THE MOTIVATION OF PHYSICAL SEQUENCES

Motivation is, therefore, not peculiar to mind. Physical processes also have their drive, their propulsion, their dynamics. The nature of mental motivation may, in fact, best be approached by a brief consideration of just what is implied in the dynamics of physics. Only to the naïve mind does physics deal with powers, forces, or energies. These terms may, of course, be employed, although their use is more characteristic of the primitive levels of physical science. They are actually only assertions that sequences *do occur*, things *do move*, processes *go on*. The primary fact for physics is displacement or movement. Energy and force, matter and resistance, velocity and acceleration, are only convenient terms for the crude description of the *ways in which* and the *conditions* under which changes occur. As speedily as possible bare mathematical symbols are used in place of the verbal concepts which the elementary student so readily personifies.

We need not, however, become involved in the complexities of mathematical physics. When one billiard ball, in motion, strikes another, something happens. The second ball moves, and the movement of the first is much modified or is wholly lost. Why does the second ball move? What is its motivation? Science has never discovered why this happens in any other sense than that of describing its correlations—the conditions under which and the way in which it occurs. Under

certain conditions, if ball *A* while in motion strikes ball *B* (this situation being the antecedent) the latter moves (this being the consequent, or part of it). Both may be highly particularized. It may be shown how the precise movement of *B* varies with the movement of *A*, with the character of *A* and *B*, and with various attendant conditions. The *variables* of such a situation are indicated by such words as mass, velocity, friction, momentum, rate, direction. Or they may be indicated by non-verbal symbols, such as m, v, s, t, and so on.

But the motivation or force involved is merely the fact that the sequence *does occur*, occurs in just the way it does, and occurs similarly under similar conditions. We may indeed use highly general terms to indicate the abstract features of such diverse occasions, such words as space, time, energy. But such terms, even in their highest reaches and most general applications, are only names given to particular descriptive features of diverse sequences.

When we turn to sequences in which partial cues are effective, we need seek for nothing more occult. That reduced cues may be as effective, or nearly as effective, as total antecedents formerly were, is of extreme importance. It will be urgent to learn as much as possible about the conditions under which reduced cues may become thus effective. But there will be no occasion to place behind these mental sequences any such mysteries as "psychic power," "hormic energy," "telic drive," "libido," or "entelechy." We shall require them in science no more than we need demons, angels, fairies, and Santa Claus. With the pleasure or value of such notions for other than the descriptive ends of science we shall not be concerned.

DRIVE OF MENTAL PROCESSES

The drive in psychology, is therefore, the observed fact that every cue has its consequent, that sequences are impulsive. In the psychology of the human being, for example, we find such things as the following. When an average infant has its eyes open and directed toward one point, the parent introduces a bright light on either side, within the field of view.

This is followed by eye movements toward the locus of the light, on the part of the child. Such reflex sequences continue to occur throughout normal life.

As thus described (from the point of view of the parent) the reflex is an objective sequence which "any one" may observe consistently with others. This may be done either directly or through instrumental records used as signs. There is also a correlated set of observations which a physiologist may make, or at least a story which he tells, on the basis of fragmentary observations. This concerns that long series in which chemical changes in the infant's retina are followed by neural currents, in the optic nerve. It culminates in coördinated patterns of contraction and relaxation in the muscles of the respective eyes. The dynamism of this series can be accounted for only by getting sections as close together as possible (as with the billiard balls). It is hoped that if the steps are sufficiently close the mystery will be less obvious.

Nor are the parent and the physiologist the only observers. The subject himself, if old enough to have acquired a technique, will report other events in nature. He reports, for example, the appearance of a particular visual pattern, a vague brightness to the right of a clear point of regard. This is followed by a characteristic shift in the pattern of ocular kinæsthesis, an obscuring of the original fixation point, with correlated clearness of the new pattern of brightness.

Since all three observers are respectable, each accepts the other's report. Such reports are so closely intercorrelated that they are accepted as descriptions of aspects of a complex and coherently organized event in nature—the ocular fixation reflex. Each reported procession is a sequence of natural events. The "unity" attributed to them is only a convenient term for the intimate correlation of their various reports.

Perhaps such a reflex sequence is the "least mental" affair with which psychology has any particular business. There is the doubtful suggestion that the peripheral appearance of such a visual pattern in some obscurely derived way symbolizes dangerous situations in the life of the species. And there is the fact that such reflexes may be "trained" so that response

follows reduced or concurrent cues. These facts give even such relatively isolated reflexes a claim to the redintegrative badge and to psychological attention.

If in such a situation we wish to apply such a word as "motive," the only sensible thing is to use it as a synonym for the antecedent, stimulus, or cue which *initiates* the process. If such a motive is found to function redintegratively in terms of its past contexts, it might also be intelligible to call such *past contexts* the motive. After all, it was by virtue of the past context that the present cue acquired its present potency. We might, therefore, define the motive in either of two ways, which would really be synonymous. We might say, "The motive is the former antecedent complexity as represented by the present partial detail." Or we might say, "The motive is the present cue as it acts symbolically for a former complexity." A mental motive, a psychological drive, is, therefore, a present stimulus.

THE SATISFACTION OF A MOTIVE

The term motive is often misleadingly applied to the end or consequent of a process. But surely it goes counter to common sense as well as to scientific method to look for the *drive* of a process in its terminus or stopping point. A drive or motive, in any dynamic sense, is that which *initiates* the process, keeps it *going*, and disappears when the process ceases. Only if this *end* be in class with former contexts, and be now represented by a present symbol, could the terminus be said in any way to have been the stimulus. And then it would not have been effective *as end* but by virtue of whatever present stimulus functioned for such past contexts. We shall have something to say later about "ends" in this sense.

The motive, as an initiating stimulus, is realized, fulfilled, or satisfied, when its consequent occurs. It *issues*, in that consequent. Antecedent thus *gives way* to response. Even in physics the first billiard ball "stops" when its "work" is done. The *satisfaction* of a motive is, therefore, its cessation, consists in its removal. The cue is realized when it is succeeded by its

consequent. In any mental sequence, then, we mean by motive the antecedent which initiates a process and instigates a consequent.

There are many easy and obvious illustrations of the way in which consequents eliminate or fulfil their cues. The eye closes when a stream of air blows against the cornea, and the stimulus is thus interrupted. The pupil contracts when a bright light illumines the interior of the eyeball, and this very contraction reduces that illumination. An offending fly on the cheek is "brushed away." Hunger pangs lead to eating, which allays the pangs. Thirst is quenched by the drinking to which it leads. Fatigue leads to quiescence; fear to flight.

The disagreeable acquaintance is snubbed and thus "put in his place"; the hateful enemy is attacked and, if all goes well, is demolished. Dread of a penurious old age leads to thrift, and the stimulus vanishes as the consequent accumulates. Love cravings are relieved by the caress and embrace which they instigate. The horrors of war lead to international organizations which proceed to eliminate the very cue which prompted them.

It would be only confusing to say in such cases that the motives were "to brush away the fly," "to eat," "to drink," "to flee," and "to arbitrate." These responses are the means or the instruments. Purposeful activity is thus a circular affair; the motive leads to responses which eliminate the motive. This elimination may, if we like, be called the *purpose* of the activity.

The error of the traditional psychology of motivation lay in a confusion of the cue and its removal with its observed means or instrument. Thus the motive of a boy's activity may be the prickly heat of his skin. Now a particular motive may often be canceled by any one of numerous techniques. Thus the boy may be relieved of his motive by lying in the shade, by gentle fanning, by immersion in the bathtub, by opening the windows, by going swimming, falling asleep, or drinking cold beverages. Traditional psychology would attribute to the boy one or more of this long array of acts or

means as motives, whereas the true motive is in all events the prickly heat of his skin, which he seeks to relieve.

Since traditional psychology thus calls different motives the whole array of instruments or consequents, any one of which may satisfy a given real motive, it has been led straightway into other errors. Thus it accepts readily and even greedily the incomprehensible doctrine of "sublimation" as advanced by amateurs. This doctrine teaches that one motive may be substituted for another, one *libido* transmuted into some other drive. Since it is true that if one instrument does not remove a stimulus another may avail, this doctrine has found ready acceptance, and the blind have led the blind. But the motive is not the instrument. One motive is not sublimated into another, although one instrument may be substituted for others. When such substitution is observed, instead of marveling at the mystery of sublimation, we should look behind both techniques for the actual persisting stimulus which either technique may allay. Even if interested solely in therapy, rather than in a description of nature, it has yet to be demonstrated that misleading jargon is superior to careful statement.

TRANSIENT AND PERSISTING MOTIVES

Some motives are "by nature" fleeting, as the flash of lightning or the crash of thunder. Some are "by nature" persistent except as they are modified by their consequents, as excessive illumination or an itching shoulder blade. In some of these, as the illumination, facile responses quickly produce adjustments. In others, as the shoulder blade, alleviation is more awkward. In some cases, native or inherited connections are provided; the pupillary reflex need not be learned. In others, long processes of learning are required before a prompt technique of alleviation is established. In many, as regret for the brevity of life, or horror of the wastefulness of sleep, no adequate solution may ever be available.

The term motive may with some justification be employed to denote particularly the less transient, the more persistent, of such stimuli. These may be persistent because they are

"by nature" recurrent or continuous, or because their various life spans are considerable and ready techniques of elimination fail. For such a motive the term "craving" is often used. In this sense the term craving applies particularly to features of an object which are not strictly social but are reportable in the main by but one individual—the "pang" of hunger, the "longing" of envy.

For the typical motive is a complex natural event. It may involve items reported by all (objective) as well as cravings accessible only to the actor (subjective). Thus "the annoying insect on the cheek" is reportable by nearly any observer. It is, to the bystander, a pattern, chiefly visual, in space and time, with perhaps imaginal and other perceptual features less conspicuously present. To him on whose cheek it is, the insect as a natural object is rather differently configured. It is chiefly a tactile, algesic, and affective pattern, also temporal and vaguely spatial, with perhaps other less prominent perceptual features, such as visual imagery. The most effective item to him may be the affective constituent of the situation —the felt annoyance. To the bystander the most effective items are color and shape.

As the insect moves about on the surface of the body, the annoyance persists while other details change. The spatial factor (the locus), the temporal features (rate of movement), and the attendant imagery are fugitive and varying. Either through circumstances of heredity or of learning, the individual sets about such activities as have in the past (of species or individual) resulted in the alleviation of such annoyance. These are perhaps vigorous activities of some other part of the body, one or more of which might brush away the annoying insect (including the annoyance).

The general field and character of these motor activities will be determined by the persisting clue (annoyance); the movements will, for example, be vicious and destructive. Or in any given movement such features as this will "spring from" the persisting cue. The annoyance as a natural event brings into play or into tentative or symbolic activity (readiness) a general *field* of consequents. These are arm move-

ments, for example, rather than eye movements; they are even a limited set of arm movements, having in common their vigor and destructiveness.

Such a *persisting* stimulus we may hereafter call a *motive*. Within the field of consequents set up or specified by this motive, will be instigated from time to time particular overt and complex movements. These will be determined, in general character, by the motive; in particular direction, rate, and succession, by the more transitory cues which the situation affords, and which constantly vary.

That human motives, for example, are so often such annoyances, needs, wants, cravings, attitudes, dreads, appetites, organic states, and kinæsthetic sets is an interesting fact. But it is not a fact of any great systematic importance. It is their persistence, not their whereabouts, that makes them motives. The distinction between events inside the organism and those outside is of no great psychological significance. And the distinction between objective and subjective is of value only for statistics and for neighborhood gossip.

The annoyance of the fly, the beauty of the picture, are intrinsic features of these objects or situations. They are as truly "in the fly" and "in the picture" as they are "in me." We must reject that naïve story of nature which puts the affective qualities in the reporter and the sensory qualities and various relations in the outside objects. For the body is also an object in the reported world of nature. The distinction is the old paradox of the "dual universe" against which we have had to contend from our earliest chapters and must still protect.

We cannot sensibly say that the pleasantness is "in my consciousness" whereas the picture is in another world. The pleasantness is where the picture is; it involves both the picture and the reporter, it is neither in the one nor in the other, but in the situation. That it is relative to the reporter is, of course, true. But so is it also relative to many other features of the situation. Relative also are the supposedly intrinsic features of the picture, its color, shape, familiarity, and theme. And in recent days, even the hard-headed physicists have been

convinced that its supposed primary qualities, as its duration, extension, and other spatial features, are also relative.

SYMBOLIC REPRESENTATION OF PURPOSES

It follows from the account just given that the typical human motives are wants, needs, annoyances, discomforts, cravings, which it is the effect of activity to change or eliminate. So long as things are satisfying, activity is not required and may even bring distress. In a sense then, human life is a struggle for complacency. Since the most complacent of conditions is that of profound sleep, we spend a third of our lives thus occupied. During waking hours some eliminate their motives by deadening their sensibilities with drugs. Others flee from the neighborhood where such stimuli arise, and are chagrined to find that they carry with them symbols that remain effective. Some, as we have seen, react symbolically (retreat to a world of phantasy) in ways calculated to annul their otherwise unsatisfied urges. All such resorts are morbid; they are, if continued, destructive of race or individual.

The healthy mind is one in which action is addressed directly to the removal of noxious stimuli. Its repose is measured by the degree to which these activities succeed. Healthy activity is thus directed straight upon its stimuli. But its modes are many, and in modern life most of them have to be carefully learned. Such modes can be acquired through learning because of the human capacity for symbolism. Activities which in experience have effectively removed annoyance may subsequently be represented by their symbols. The arousal of such symbols may be the first effect of the motive, and when thus aroused they become part of the stimulus to further action. Imaginative solution, the tentative representation of more overt consequents, is thus one of the first steps toward active adjustment.

Our army officer at his wall map is strongly motivated. The known situation of his troops and information concerning the movements of the enemy combine to constitute a predicament, an annoying, humiliating, terrifying present situation.

This is the stimulus to his activity as a whole. It leads him to the map and determines the general direction of his movements of the symbolic pins; they are all forward movements, for example. The potency of such a motive is not an occult power; it is the result of a long history of previous learning.

But the details of the movements—whether they are rectilinear or curved, long or short—are contingent upon local cues—the signs of valleys and woods, of bridges and mountain passes. The motive specifies; local and transitory cues instigate. The motive is thus a general directive agent, a control, a limitation, a determining factor. The instigation of transitory cues occurs in the general direction and field thus mapped out beforehand by the motive. The "mapping out" or determination seems to consist in symbolic arousal. There is tentative and partial production of a great array of responses, which are thus more easily instigated by local cues than are other specific acts also connected with them through heredity or learning.

If the likely mode of salvation has already occurred in imagination, there is a present symbol for it. Such a symbol may be for example the words "Get out of the mountains," or "Reach the railroad." It may be instead visual imagery of such finalities, or symbolic gestural and postural kinæsthesis. It is more likely still to be some complex of these, now one and now another featuring functioning for situations of a kind which solved such problems in the past. The solutions may have been directly encountered in the officer's own life. Or he may have vicariously and symbolically encountered them in reading of the campaigns of Napoleon or in his military classes in tactics and strategy. In such cases this symbol of a solution persists along with the annoyance. Both conspire to constitute the *purpose* and both may lapse when the activity ceases.

A purpose, *a symbolically represented mode of eliminating a motive,* becomes a part of the persistent stimulus, hence a part of the motive. Symbols are, therefore, required which may be conveniently prolonged by the annoyance which is their immediate cue. For such use images are unsuited be-

cause of their fleeting character. Words, because of their transient occurrence and the brief explosiveness of articulation, may serve only if reiterated. Most effective in this regard are bodily postures and their kinæsthetic patterns. Definite sets and fixations of tonus, asymmetries of tension, directions of regard, are particularly easily maintained throughout otherwise diverse activities. There is evidence that intentions, plans, instructions, and commands are commonly symbolized largely by such motor sets. But in their occasional lapses, equivalent symbols, as words, images, feelings, gestures, and various relations of these, arise in their stead. Usually indeed a complex pattern, unstable in content but firm in meaning, is present. It is the complexity of this pattern of purpose that gives to each its special character and prevents confusion with other purposes.

THE REDUCTION OF PURPOSES

In a familiar laboratory experiment the subject is required, in the case of a series of two-place numbers, alternately to add and multiply the digits comprising them. Thus if the first few numbers in the column are 65, 39, 72, 84, etc., the task being "add, multiply, add, multiply, etc.," the answers would be 11, 27, 9, 32, and so on. The subject acts under two types of cue. First there are the local and variable numbers, to be handled as they occur. Then there is the "instruction," "Alternately add and multiply"; this is the specifying cue. Both types of stimulus are present throughout. The instigating stimuli are automatically provided by the test sheet. The specifying or control cue is first given orally by the experimenter. How is it sustained throughout the series? Observation shows that something like the following happens, with variations.

First I hear the oral instructions; these are aural events, heard words. Their auditory images linger, and as they fade I say to myself in audible or silent speech, "add—multiply—add—multiply," meanwhile beating time by raising the toes of my left foot, then pressing them against the floor. These

movements happen as a carry-over from other situations of counting or beating time. Adding is easier; it is the lifting toes. Multiplying is harder; the toes press firmly against the sole. Soon speech lapses, but the toe movements go on, effectively guiding my operations with the numbers on the test sheet. Toe movements become surrogates for the aural instructions. In time these movements themselves diminish in range and vigor. Now they are mere release and pressure on the sole, chiefly of the big toe. In a long experiment, as my toes tire, I find speech recurring again. "Add—multiply—add—multiply" comes again, perhaps also with renewed auditory imagery of the experimenter's voice. And now tongue or head, unoccupied hand or foot, or vaguely distributed tension and relaxation of other parts, as in breathing, carry on the rhythm, as speech and imagery again lapse.

The heard words, "Alternately add and multiply," were able to guide me because they function for larger contexts, as we have seen in our account of language. They *really lead* to alternate adding and multiplying. So also do the words as faintly articulated by me. So also do the movements of toe and diaphragm. They become, for the time being, significant cues, in the light of their recent history. There is nothing strange about the fact that in other contexts the same movements might assume quite different meaningfulness. So also may words—for Add and Multiply may elsewhere be the names of two pet kittens.

Reduction, in other words, is as characteristic of the specifying cues of purpose as it is of the instigating cues in learning. In such an experiment as the one just described the two go on together, and this constantly occurs in daily life. As time goes on the cue of purpose or specification may become as slight as that of instigation, so slight as to elude precise description. Since it may and typically does readily and rapidly shift from one to another available detail, the introspective description of developed purposes is exceedingly difficult, and readily leads to the stimulus error—another symbol for the original context rather than an account of the present symbol.

So subtle, indeed, do such cues become that some frantic

psychologists have despaired of identifying the cues of purpose, and have attributed their guiding power to the mandates of an occult soul. Capitalizing their ignorance and the name of its object, they provide even the bees and wasps with otherwise unaccountable Purposes. Others, equally hopeless and baffled in the identification of shifting and vicarious symbols known only to the actor, look always for "physical stimuli." Thus they quite overlook the extreme psychological importance of subjectively known events such as feelings, imagery, kinæsthesis, and their various relations.

To appreciate the unreasonableness of such extremists we have only to remember the ease with which, in drowsiness and dreams, varied items are vicariously substituted for less available symbols. The same phenomenon constantly occurs in the purposeful and motivated sequences of waking life. Purpose cues are easily drawn from events on either the symbolic, the affective, or the postural levels (as imagery or words, feelings, and attitudes) or the relations of any such items. So also may motives of the persistent type be derived.

But motives are more characteristically affective. They are predominantly such events, at least, as are closely correlated with "general bodily condition." As in hunger, nausea, and thirst, they are often closely associated with immediate sensory qualities. In fear, lust, and envy they involve instead the complex perceptual aspect of elaborate personal and social situations. It is in large measure to such facts that they owe their relative persistence. We shall consider them more fully in the chapter on feeling and emotion.

THE ORGANIZATION OF PURPOSES

To enumerate the major purposes of almost any creature would be thankless and perhaps endless. For any event or act to which events might lead might be symbolized and embodied in a motive. In the case of human beings, all man's plans and intentions, programs and expedients, would have to be included, and the innumerable modes of symbolizing them described. The task is increased by the fact that in a

developed system, as we have seen, each consequent comes in time to reflect the whole biography of the individual. Not only do purposes change but so also do the symbols involved in them. Although the trivial laboratory intention "Alternately add and multiply" may endure for only a fleeting hour, many purposes persist and grow and are varyingly represented throughout a lifetime.

Under the general rule that some consequents are more easily instigated than others, there occurs a hierarchy of potencies which might figuratively be called an organization of purposes. Various human cravings, as they occur, have varying degrees of coerciveness. The various ways of alleviating them come also to differ in the ease or likelihood of their appearance. Certain urges and techniques of satisfaction thus stand out as dominant. And for each urge there comes to be a hierarchy of adjustments which becomes in time the character of the individual.

Thus many sensory qualities in the field of the lower senses, such as taste, smell, contact, may lead to violent organic revulsion; they are immediately and intrinsically distasteful. Pains are even more coercive, sights and sounds much less so except as they come to function for past contexts. In the same way we may compare such urges as shame, lust, and fear. In each there is, of course, a range of degrees, and accuracy would require that known and specified degrees of each be compared. Such measures are not yet available and it may well be that high intensity of any one of these may be prepotent to lower degrees of any other. But the common fears of men are dominant over ordinary lust, and this in turn is stronger than the average degrees of shame. Striking personal or temperamental differences are occasioned by individual variations in the status of such typical urges.

Differences in direction and strength of purpose are equally clear and significant. Thus human beings may eliminate a fear motive by various expedients, such as collapse, flight, personal attack, or organized action. One may react to a distressing sense of personal failure by suicide, sulking, self-pity, irritability and lament, blaming others, braggadocio, candid

inventory and confession, or deliberate self-reform. Preferred tendencies on one or other level may be habitualized and characterize the individual's adaptation to any feeling of guilt or shame. They thus constitute the character types and their varieties. How far such differences are constitutional is still a matter of uncertainty. But that once established they make for varying degrees of social, industrial, artistic, and scientific adequacy and health, seems apparent. The strong motive and the forceful purpose are thus present stimuli of dominant specifying and instigating power. The conditions under which such potency develops is an outstanding problem, on which there is much assertion but little evidence.

DESCRIPTIVE AND FUNCTIONAL PSYCHOLOGY

The reader is no doubt exasperated by this meticulous account of the mechanism and dynamics of motivation. He is, perhaps, bored by so much abstract description and impatient for a more vital account of human motives. Such an attitude is also that of the billiard player. He cares not a whit for the science of mechanics. What interests him is whose ball it was, and whether it went into the pocket. Even the director of the recreation room is apathetic to the mystery of movement. His concern is with the popularity of billiards and the function of this game in the life of humanity. Does it help break up the undesirable neighborhood gangs? Does it encourage proclivities for gambling?

There are, then, other interests in billiards than those of the physicist. Most people would be much concerned over *which plan* our army officer finally adopted. How he did so, and what particular symbols he used from moment to moment, these topics would leave them cold. The astronomer is absorbed in recording the transits and orbits of stars and planets. He endures the cold and undertakes long journeys, that his observations may be more precise and complete. But what the mariner wants to know is how all this is going to help him find his way to port on a stormy night. This distinction between descriptive and functional interests is, therefore, far-

reaching. In our particular case, it is the difference between descriptive or systematic, and functional or applied psychology.

The public speaker is less interested in understanding the surrogate rôle of speech than in knowing what words are most stimulating, what current topics most intriguing, and what jokes are new to his audience. The teacher is less interested in the process of cue reduction than in being told just what classroom methods will most quickly and surely accomplish it. The salesman is indifferent to the way motives evolve, and the stuff of which they are made. He wants some way of knowing at a glance just what motives a particular prospect has. No lover cares what symbols, if any, the adored one subjectively employs. His worry comes from uncertainty as to just what objects and contexts those "ideas" represent.

Not motivation but its consequents, not purposes but their probable outcome, is the concern of practical life. Not descriptive psychology but the lore of human nature is what appeals to parent, teacher, advocate, and writer. And it is part of the business of psychology to minister to this craving. The tasks of science include not only description and correlation, but also conjecture and application.[1]

But before the astronomer can serve the navigator, he must arduously complete and correlate his data and charts. Many of these will be of no apparent concern to any particular sailor. Before the student of psychology can apply his knowledge, he must first acquire it. Before he can intelligently deal with particular acts of learning, of imagination, of memory, motive, or purpose, he can profitably know what general principles such processes involve. Before he is fully equipped for such practical dealing he may find it necessary to supplement his knowledge of general or systematic psychology by excursions into more special and intensive fields, such as child study, education, neurology, æsthetics, human engineering, and psychopathology.

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[1] See Appendix I for suggestive accounts of the array and classification of human motives in terms of the situations they represent.

RECAPITULATION

We may now briefly summarize what these general principles are in the case of motivation or mental dynamics. Motives are not vaporous entities, hovering tenuously about the individual. They are concrete, particular events in nature. They are actual present stimuli which lead so directly to other events that their nature is often easily mystified. Chiefly, in human life, motives are annoyances. They are occurring patterns or complexes, of sensory, affective, and relational items. They often involve the general state of the organism as part of a total situation which includes other objects or events. Typically, motives are felt patterns of distress, want, craving, annoyance. In daily life, instead of describing them, we apply to them the names of situations in which they originate or of the results to which they lead.

To satisfy such a persistent stimulus or motive is to remove it or change it for less annoying stimuli. Often motives may be annulled by any of a variety of consequents. Such consequents, however, are not motives. They are means or instruments for alleviating motives. Motives are impulsive; they urgently lead to responses. This fact gives mental activities their drive and constitutes their energy.

Such techniques of alleviation may be "in mind" before they occur "in fact." This we have clearly seen in the chapter on imagination. When they occur "in mind," they are plans, intentions, programs—patterns of symbols. For them to be "in mind" means precisely that some present fact is a symbol or sign of them; for mind, as we have seen, is the field of symbols. A plan or intention is, therefore, the presence of a symbol which, as part of a course of action, enables this to occur tentatively, in outline, as "idea." Any available items, as we have seen, may constitute such symbols; but typically, in humans they are patterns of imagery, words, or the kinæsthesis of gesture and posture.

Such a symbol or plan is first instigated by the motive or annoyance, on the basis of previous learning. The two coexist or coöperate in the production of further events. This joint

presence and effectiveness of motive and plan constitutes a purpose. A purpose is, therefore, the occurrence of an annoyance along with some symbol for a technic of removal.

Motives and plans are of varying potency; hence, purposes have varying strengths. These variations depend both on "native" differences and on the "history" of learning. In their varying organizations of potency and strength they constitute the individual pictures of temperament and character. A motive or intention may be either conscious or unconscious. By this we mean that among the consequents to which it leads there may or may not be an event which is a name, a synonym, or report of it.

CHAPTER XVII

THE CONSEQUENTS OF MENTAL ACTIVITY

THE COMPLEXITY OF SEQUENCES

Up to this point in the account of mental processes, special attention has been given to their antecedents or cues, and to the variations of instigative potency. Less consideration has been paid to the consequents or responses which such sequences may involve. Theoretically, of course, any natural event may be considered either as stimulus or as response. It is at once the effect of its causes and the cause of its effects.

Strictly speaking, the cause of any event is enormously complex; necessary conditions ramify into remote quarters. At this moment I am writing particular English words on a particular sheet of paper, with a particular pencil. No one fact in nature can be entirely blamed for this. No conceit is involved in intimating that the whole history of the universe up to this time has something to do with one or another aspect of such an act. Had the flood not subsided, had Columbus not discovered America, had language not been invented, nor paper manufactured, had Britain not been a dominant world power, had I not survived the automobile accident, had the stationer not extended credit, and had I only a better pencil, the act as described could have been prevented.

But we must consider such an act as in reality highly complex. Thus we may inquire more or less legitimately into such details as why *I* am writing, why *now* writing, why *writing* rather than drawing, why *English,* why with *pencil,* why *this* pencil, and so on indefinitely. When such details are considered, threads of events more or less observable constitute discriminable but far from independent sequences.

Any such event, once given or produced, may serve as the cue of mental process. May every such event be redintegratively *produced?* Any event may be the cue; can all events also be consequents, in a mental procession? To answer such a question involves us in many complexities. For one thing, we must be somewhat more particular in our use of the word "event." Is the word to be used for any part of a set of correlated facts, or only for the whole correlated array?

THE PHENOMENON OF THE KNEE JERK

Let us take the relatively simple case of the knee-jerk reflex as a sample. The rubber or wooden hammer strikes the knee. This is an event observable both by experimenter and by subject, and it might be recorded also by a motion picture camera. The muscle swells and the foot flies upward, then settles back. This also is reportable by experimenter and subject, and recordable by the camera. Evidence, partly direct, partly indirect, is also securable, in theory, concerning intervening events. Thus, if we suppose that the knee jerk is a true nervous reflex (rather than a direct reaction to mechanical impact on the tendon), something like the following is either observed or conjectured.

The blow disturbs the equilibrium of a nervous tract which extends from skin and tendon to the spinal cord, thence back to the muscle of the leg. This equilibrium disturbance is propagated from point to point along this tract and results, when it reaches the muscle, in the shortening of that muscle and resultant movement of the lower leg upon the knee joint. Thus conducted out of the physiological system, the energy change is dissipated in the universe at large, and equilibrium is again restored. As thus described, the knee reflex is a mechanical occurrence in space and time, visually observable or recordable by devices subsequently visually examined (motion film, kymograph records).

But the subject of the experiment has more to report. Thus he observed a sudden and smart pressure quality, localizable just below the kneecap, with perhaps accompanying visual

imagery of the leg, and activities of naming and retouching. Thereupon or even earlier than some of these he observed a sudden and brisk kinæsthetic pattern, running a definite course, with joint and skin qualities, commonly correlated with seen leg movements.

This sequence of events, reported by the subject, is also the knee jerk. It is at least as valid a part of it as the visual sequences reported by others. It is a fact that the visually observed (and mechanically interpreted) series could be "indirectly recorded," whereas the "subjective events" could not. But these are only limitations of observation, presence, or absence of further correlated facts. Indeed, the indirect records may even be correlated with the subject's report almost, if not quite, as uniformly as with the visual observations of the experimenter. To suggest that all these are only "appearances" of something more "real" that was going on is only to substitute magic for natural observation.

The knee jerk is both a visual sequence and a tactile-kinæsthetic sequence, as well as whatever other sequences (mechanical?) are directly or indirectly correlated with it. The subject of the experiment is here capable of both observations. The changes in his visual field, as he watches the leg and hammer, are no more genuine than the changes in his fields of pressure and kinæsthesis. The only difference between them lies in the fact that the one sequence is corroborated by other eyewitnesses, whereas no one else observed the shifts of pressure and kinæsthesis.

In both these series comprising in part the knee jerk we find antecedent and consequent. Felt pressure introduces felt kinæsthesis. Visual (mechanical) impact leads to further visual (mechanical) changes (nervous impulses, leg movements). Either the felt pressure is a feature, along with the visual (mechanical) impact, of what may be called the total antecedent, or else the impact played a double rôle. On the one hand, it introduced the felt pressure and the kinæsthetic pattern. On the other, it aroused the observed or conjectured nervous impulse (theoretically visible) and the spatial leg displacement (as visually observed).

REDINTEGRATION IN THE KNEE JERK

The physiological trend of modern psychology has inclined it toward a one-sided story of such a complicated affair. Since the mechanical features (directly and indirectly reported movements) of hammer, nerve current, muscle, and leg are verifiable both by subject and by experimenter, these are accepted as somehow more "real." Back of them or in place of them is substituted a play of inferred or conjectured "energies." Events reportable only by the subject are tossed aside as ineffectual happenings in a world of consciousness. This interpretation we have frequently encountered, and as often repudiated throughout these chapters. It cannot be too often insisted upon.

Redintegrative sequences may occur in either series. The knee jerk, as mechanically described, may be "conditioned" to sounds. And the leg may kick (mechanically as well as kinæsthetically) upon a "fancied" as well as upon a socially verifiable insult to its equilibrium. Psychologically, therefore, we are not concerned with the historic struggle to split nature into two worlds. Our concern is with mental (that is, redintegrative) sequences wherever observed and by whomsoever. We are, therefore, free to consider any observable course of events (whether individually or socially reported) in which the relation of antecedent and consequent may be reasonably established.

QUALITIES, STRUCTURES, AND SYMBOLS AS CONSEQUENTS

In an early chapter we have seen how varied are the subjective events that may be provoked by details of their former stimuli. Qualities and patterns in the various sensory modes are thus produced in the form of imagery, synæsthesia, and number form. In vividness, intensity, organization, and vivacity these redintegrated sensory and perceptual patterns range from patchy and washed-out structures to those readily confused with mechanically aroused sensory affairs. There is no sensory mode in which such images have not been reported,

although modality differences in frequency and vividness are common in human adults.

Any event or act commonly used as a symbol may also be thus redintegratively produced, by partials of former cues. It is this sort of sequence that has played so large a rôle in psychology as "the association of ideas." For ideas are symbols, and if symbols may be aroused by partial cues, one symbol thus evokes another. This we have seen to be a common occurrence. I announce the postman on hearing his footsteps. One symbol thus arouses another. In rote recitation there is "a train of ideas." Not only does one word lead to another. We have seen that even "part of a word" (its kinæsthesis) may lead alone to another word. Dominant letters or the mere shape of a visual word leads to the spoken word equivalent. In recognition, in space perception, in memory, in imagination, one symbol evokes another.

THE ASSOCIATION OF IDEAS

But the association of ideas has been much overrated in the history of psychology. This happened partly because when all ideas were supposed to be images the mental realm was practically limited to observed imagery processions. At a later time it became necessary to recognize ideas of a non-imaginal variety. But they were then described as universals, pure thoughts, meanings, and contrasted sharply with "things." Things were described as associated "in fact." Ideas, in their flow, were then supposed in some way to *reflect* the physical associations of things. Or "brain processes" were supposed to be associated, on the basis of the factual relations of things arousing or corresponding to them. Brain processes then, in turn, dictated the succession of the ideas "accompanying" them.

With these puzzling entanglements psychology was enabled to enlarge its chapters to a formidable size. "Laws of association" were writ large in every text. Lively debates were staged over similarity, contrast, contiguity, succession and congruity as presumed influences *responsible for* these linkages

of symbols. It remained for a logican, Bradley, to insist that similarity presupposed two things already there, that things contiguous were never associated, and that things associated had never been contiguous. But even the critic failed to see the simplicity of the facts, and was soon engulfed in a realm of "purely logical" universals.

If half of all this energy had been directed toward discovering what ideas are, psychology might now be further on its way. Similar ideas arouse each other? But the ideas cited, two words for example, such as "sister" and "mother," were often as different as two words could be. These two for example are not so similar as "brother" and "mother." The words neither look nor sound alike. Oh, but the things for which they stand are alike? Well this, at least, is not similarity of *ideas*. No sister or mother will confess to being an idea. At least in so far as similarity is a law of mental sequence it seems to apply to the similarity of the "signified" rather than to that of the "signs."

How about contiguity then? The case here is just the reverse. Contiguous things by no means tend to establish connections between their respective ideas. The opposite is more often the case. "North" suggests "south," rather than "northeast" or "northwest." The ideas for remote rather than for adjacent points of the compass are here associated. The law of contrast then, perhaps? Well, any one who insists on having both a *law* of similarity *and* a law of contrast is simply trying to beat the game. He is like the familiar psychoanalyst who explains everything on a *love* basis until the theory breaks down, then tries *hate*. The fact is that contiguity has little effect unless one item is an antecedent, the other a consequent. But then our connection is already provided for.

The association psychology looked in the wrong place for its data. Plenty of things are linked in sequence besides ideas, and follow one another in mental processions. In so far as ideas are thus linked, it is through no peculiarity of symbols. It is because they occur in or otherwise involve a system which manifests redintegrative characteristics.

Words, gestures, facial expressions, symbolic attitudes, overt

or kinæsthetic, are easily instigated by partial stimuli. The general principle is neither similarity nor contiguity merely. It is the substitution of partial details of former antecedents (here is similarity, partial identity) in the instigation of consequents similar to former ones (here is both contiguity and similarity). The original antecedent may be, for example, a complex spatial situation. It is not a symbol; but the response may be an identifying symbol ("far," "near"). Thereafter a partial feature (hence a symbol) of the situation effectively instigates a similar response. One symbol introduces another.

POSTURAL CONSEQUENTS; REFLEXES, HABITS, INSTINCTS

On the postural level we may roughly classify the possible consequents as reflexes, habits, and instincts. We have already frequently illustrated typical reflexes, and have shown that at least some of them may be so trained as to be evoked by partial stimuli. Thus the knee jerk, the pupillary reflex, the eye wink, the salivary reflex, blushing, may be conditioned to concurrent stimuli such as sounds and words.

Indeed, after such conditioning a third stimulus may be introduced and in turn made effective, by applying it frequently with the sound alone. Contiguity is effective, not contiguity of stimuli but contiguity of stimulus and response. Thus the repertoire of animal behavior is natively limited, but by "associative shifting," performances are attached to a wide range of stimuli, with varying degrees of intensity, vigor, discrimination, and combination. This is the process of learning.

Habits behave similarly. Habits are built of reflexes, often of reflexes so vague and unspecific as to have been called "random movements." The term "habit" is very indefinite. Fundamentally it means an acquired connection as distinguished from a native one. Words represent habits. Mental images may become habitually used or neglected. Conditioned reactions, even conditioned reflexes, are habits, in the sense that they are learned connections. All cases of cue reduction, as in space perception, are habit, since a stimulus not natively

effective becomes so by repetition, under the redintegrative paradigm. As we shall see later, feelings and emotions may also have a habit basis.

THE CHARACTERISTICS OF HABIT

On the postural level, habits consist of orderly systems of voluntary movements. As we shall see in the chapter on decision and choice, voluntary movements are those capable of linkage with conventional symbols. In the first place, such movements are established as a *system* by the coöperation of many joint cues or co-stimuli. This we have already illustrated by the cases of walking, playing the piano, and manipulating the keys of a typewriter. Further progress, as we have seen, is of two sorts.

Each step or stage of the act, through its kinæsthetic and other cues tends (redintegratively) to instigate the following step. The movements as a group are also facilitated by the motive or persisting cue which gives general direction. And the local cue, which starts the process at any given moment, becomes more and more reduced as the habit is more and more firmly established. This gives the self-running appearance that leads to the characterization of the habit as an automatic act.

It is a striking fact that once a habit has been thus well established, an attempt to guide it by its old complex pattern of cues is likely to end in awkwardness. An attempt to slow up the rate of performance has the same effect, and for the same reason. In this, which is sometimes called "conscious control," the motive and local cue conspire to evoke a set of symbols for the acts, and these symbols tend to come together or "out of order." The result may be interference with the effectiveness of the reduced cues and smooth sequences already established.

The feature of habit that is most striking is, therefore, not the formation of "grooves" or "pathways" worn deep in tissue. It is, instead, the establishment of autonomous systems of movements, linked to subtle cues. What the neurological

counterpart or correlate of this increased effectiveness of slight cues may be is still a matter of speculation.

The abandonment of habits is as difficult as their formation. It is even difficult to avoid situations provocative of the habit. For the slighter the cue, as we have seen, the greater the number of contexts in which it is likely to occur. The firmness and unavoidability of habit thus arises not from the "depth of pathways" in the brain for a specific cue. On the contrary, it results from the subtlety of the cue that is effective to evoke a given response. Not the depth of any one pathway but the exceeding number of effective shallow pathways would be a better figurative key to habit.

Another characteristic that gives habits their autonomy is the way in which local stimuli of great importance are overweighed by such cues. The habitual act is likely to occur even under "inappropriate" conditions. The absent-minded man is the creature of habit. He walks out into the sunshine, umbrella in hand. This morning it was raining, which explains the presence of the umbrella. Now the mere feel of it in the hand as he steps outdoors is a cue to raising it over his head. Thus he walks down the sunlit avenue, oblivious to the jeers of small boys, to the titters of adults, and to the brightness and dryness of the atmosphere. The potent subtle detail of past contexts outweighs other present and local stimuli which determine the practical relevance of the act. Thus, also, with the trainer of the Irish terrier, aforementioned. This person, in training the animal, had much occasion for slight pats of approval and words of encouragement. During this period the recently acquired infant of a friend was exhibited. The first response to this new creature was a gentle pat of approval and the "involuntary" exclamation, "Nice doggy! He's a nice doggy!"

This is why it is often said that habit is inflexible, relentless. Subtle cues from past contexts inhibit other present stimuli whose responses are therewith incompatible. Habit is thus dictation by the past; it is conservative and obstinate against change. It has often been called "the flywheel of society"; it is also a millstone about the neck of progress in

the case of the unsagacious. Sagacity, as we shall see in the chapter on intelligence, implies alertness to local stimuli as well as effectiveness of past contexts.

Another aspect of habit is also of greater importance in mental hygiene. Activities may be so conditioned to their customary but irrelevant antecedents that they fail to occur smoothly in their absence. The individual then cannot rest content in new and unfamiliar contexts. Absence of the wonted stimuli may thus result in collapse. Even such vital functions as sleeping and eating may fail, as well as feelings of security, confidence, and worth. Depression and anxiety or general helplessness may ensue, with morbid fancies of ruin and incompetence. This is the typical picture of homesickness, in its many varieties. Hygienic habit formation requires weaning from the local cues of home and fireside in favor either of more cosmopolitan stimuli or of stimuli resident in the person of the individual. This is what is ordinarily meant by "growing up," a process which is more successful the earlier it begins.

THE GENERAL NATURE OF INSTINCTS

In the reflex, a specific and relatively slight cue provokes a definite and relatively simple response, on a native or unlearned basis. In habit, the response may also be simple but is often a more complex organization of elements which in their isolation were unlearned. The habit stimulus, originally complex, is reduced through learning so that many and varied subtle details are effective. Habits are, therefore, acquired and definitely patterned.

In many of the lower animals there appear acts, apparently on an unlearned basis, which resemble acquired habits. Thus birds form characteristic nests, bees their typical comb, moles their peculiar burrows, and beavers their unmatched dams. Acts of locomotion, flight, song, mating, incubation, feeding, and defending the young show definite and common trends. They are, however, subject to circumstances, somewhat, and modifiable by training.

Such acts proceed like motivated habits, as if directed by purposes. There is at least a characteristic end product, and each stage seems to arise from the one before it. Many of these typical performances are clearly defined by structural equipment and limitations. Fish have fins, supplied with muscles. If these are moved, propulsion results in a fluid medium. Birds have wings instead; if they are flapped with sufficient vigor and coördination, flight results.

But the delicate coördination of such acts, and their fine adaptation to biological ends, are not readily explained by any existing knowledge of structure, whether muscular, skeletal, or nervous. In the present stage of our knowledge we can only enumerate such performances and call them native, instinctive adaptations. Typical patterns of activity are thus classed with the patterns of bodily structure. Their origin is a phylogenetic problem. But some of their modifications are redintegrative and fall within the province of psychology. The following special features of such activity may be noted.

INSTINCT ORGANIZATION

Instinctive behavior patterns have various degrees of native organization. They range from definite acts or series of acts to vague and general tendencies. Their cues range from very detailed and specific stimuli to complex relational situations. A typical instinctive act in most animals is sleep. The initial or original stimulus to this act has not yet been ascertained, but it appears to be some bodily condition. But through life the sleep act maintains much of its original pattern, under all circumstances.

On the other hand, such acts as flying and nest building adapt themselves to circumstances and vary considerably, as acts, on different occasions. The nest may be made of whatever materials are available, at least within limits. It may be modified in size and shape in dependence on its location; variously buttressed, fashioned, and fastened, according to local requirements of protection and stability.

Flight and its elements seem unlearned, but there is often

much preliminary flapping and balancing before it occurs. And the particular coördinations are so adapted as to avoid local objects and to take advantage of local open spaces. Bird song, at least in some cases studied, may be variously modified by the song of other birds in the neighborhood. In the most cited human instincts the precise acts themselves can scarcely be specified at all, and the instinct can only be defined by some occasion or by some end product.

SHIFT OF INSTINCT CUES

Instinctive acts may acquire new cues; they come to follow upon partial details of their original antecedents. Whatever the original stimulus to sleep may be, various cues become in time potent to produce it. Thus a sleepy infant may be regularly placed in a given place or position, in a room either dark or illuminated. It may be sung to or rocked in particular ways, or put in special sleeping garments. The sleep may be timed in relation to particular other events, such as feeding or story telling. Thereupon any of several things may be observed.

Sometimes all these cues come to be required to produce sleep thereafter, or in cases of special wakefulness. Or certain features, regularly given in the antecedent, come to be required, as rocking, singing, or a lighted lamp. Or almost any of these cues may become sleep-inducing and productive either of sleep or of drowsiness, which is incomplete sleep. With careful management, definite cues may singly be so established that the engineering of infant sleep is either much facilitated or rendered at times difficult. The same general facts apply to many other complex reflexes or instincts of the young human, such as feeding, laughing, excretory processes, crying, playing.

MODIFICATION OF INSTINCT PATTERN

Many instinctive acts are modifiable as patterns of behavior. Certain acts or stages may be omitted, and new acts may be introduced or substituted. Thus playful babbling, manipulat-

ing, and romping appear natively in human infants. They may be trained into socially useful activities such as speech, dancing, drawing, and organized games.

The process here is similar to that outlined in the formation of higher units in learning. Separate acts, with individual stimuli or discrete cues, become cues to one another. The whole pattern may then be given in response to some initial cue. So readily does this happen that it often becomes difficult or impossible to discriminate the native from the learned features of such performances.

ORGANIC CONDITIONS AS INSTINCT CUES

The fundamental, or at least a requisite, cue to an instinctive performance commonly seems to be some persisting organic stimulus. This may be described as some need, want, irritant, annoyance, or motive. The acts which result may be specifically or vaguely calculated to remove this motive, as in yawning, stretching, laughing, crying. Calculation in this sense does not, of course, mean foresight by the actor, but a result described after the fact. The calculation is phylogenetic, not ontogenetic, in the case of instinctive acts.

The acts themselves may bring immediate relief and may not be directed toward the change of other objects. In other cases, the acts are less defined but consist of general activity upon the environment, continued until the motive is finally canceled. In such cases, the particular effective acts may need to be learned or discovered. Only after such preliminary learning do they come about in more or less stereotyped ways. Thus in combat the actual movements vary considerably in young and old, in skilled and unskilled animals. But they are in general and were in the beginning acts of attack.

CONFLICT OF INSTINCTS

Instinctive tendencies, simultaneously aroused, may have various degrees of compatibility. Instinctive activities may also be incompatible with other attitudes and modes of reac-

tion acquired as habits. Or their execution may be interfered with by structural limitations or mechanically imposed impediment. In such cases we find conflict or suppression. The motive or organic stimulus persists, and there is added to it chronic thwarting of its impulse. If postural consequents are prevented, the response, as we have already seen, may be shifted to other levels. Violent affect and active symbolization may then occur. These are the bases of emotion on the one hand and reasoning or decision on the other. Such activities we are to consider in detail in later chapters.

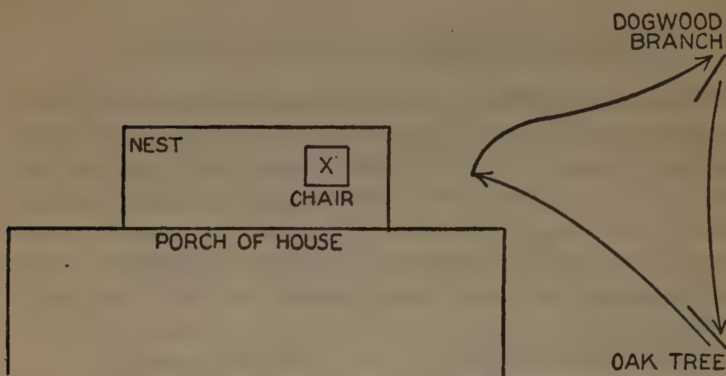

FIG. 28.—MAP OF THE SITUATION IN WHICH THE ROBIN'S CONFLICT OCCURRED.

An illustration of such conflict may suffice for the present purpose. A robin instinctively returns to its nest during the period in which eggs or fledgelings are there. It also actively avoids a strange object in motion, such as a man rocking on a porch. This latter act may be either an instinct pattern, a habit pattern, or some combination. The above diagram represents the general situation in which such a bird was frequently observed for an hour or more at a time, in a state of conflict.

The robin's nest was atop a porch pillar, as indicated, under the roof of the porch. After its occupancy had begun, the observer came and sat in the chair at *X*. The robin's common return was by way of the oak tree. There it would alight,

as if by way of a preliminary reconnoiter. Then it sailed round the corner of the house, under the porch roof, across to its nest in the far corner. We may quote from the observation, in the present tense.

As the robin rounds the corner, I come into its field of view. It promptly wheels in its flight by a line which as speedily as possible separates the bird from the observer. It stops on a conspicuous branch of the dogwood tree. After a restless moment it flies over to the oak again, and I disappear from its field of view. Quickly it sails around the corner again, as if drawn by the nest, only to be once more deflected to the dogwood tree.

As this performance is repeated the bird grows more and more restless and agitated. It hops about on the bough, utters such distressing squawks as only a frantic robin is capable of, and works up into a high pitch of excitement. Apparently the cues of this particular situation happen to be just balanced in potency, and the respective consequents are incompatible. This keeps the bird chained in its vicious circle.

If I exhibit sudden movement, fright is increased and the bird breaks from the situation. Later it may approach from a different point, avoiding the dilemma; or it may return for another session of conflict. If I keep quite immovable, the robin comes nearer and nearer to me with each circuit, and finally sails boldly past me to the nest.

"In the circuit" there is then a state of conflict. Two cues evoke two incompatible responses, approach and flight. As long as the two are about equally potent, neither response is completely executed, although both are actively prompted. The result is that increasing restlessness and agitation which we call the bird's "emotional condition."

THE MOTIVE AND THE PRODUCT OF INSTINCTS

Even the most mechanical of reflexes may be conveniently described as an escape from the stimulus. The bare transmission of a "nervous current" along a fiber appears to be the progressive reëstablishment of an equilibrium which the

"stimulus" has disturbed. Indeed, it is just this disturbance of equilibrium which, physiologically considered, constitutes the stimulus.

The immediate consequent or response is disturbance in the immediately adjacent "molecules" of the nervous substance. The process by no means terminates with the movement of a structure, as the foot in the knee jerk. The foot may be attached to a string, which pulls a trigger, which fires a gun, which hurls a bullet into a jeweler's window, and general pandemonium may ensue. Even regularly, the foot movement displaces air, produces air currents, which spread with ever increasing area and decreasing vigor. Limiting the process to the "body of the subject" is a wholly arbitrary matter.

So also with the more elaborate native acts, the instincts. They seem best described as more or less definitely organized movements of the voluntary musculature and its attachments, which have as a result the satisfaction of some immediate motive. In human beings the motive which gives the act both its impulsion and persistence, as well as its general direction, is the most significant fact. If such acts also serve some biological end in the life of the species, this is an interesting but by no means universal fact; it does not explain the instinct, though it may account for its perpetuation.

INSTINCT IN MAN

For many years psychologists have accepted it as their duty to inventory the things which human beings instinctively do. It is far from clear why this should be considered a psychological enterprise, except in applied fields.[1] Psychology is concerned, for example, with the process whereby spoken language is acquired. But psychologists have never felt obligated to compile the dictionaries nor even to inventory the "tongues" of humanity. Psychology is interested in memory, in imagery, in imagination, in habit, but has never seriously

[1] See Appendix I for suggested classifications of human instincts, and other material relevant to the applied psychology of human engineering.

contemplated the exhaustive enumeration of all the things men can or do remember, image, fancy, or automatize.

The motive for this practice has no doubt been the desire to have man's native tendencies listed for the convenience of his further education and management. The applied psychology of man thus has its place. It is what has in recent years been especially emphasized under such names as behaviorism, anthroponomy. It is essentially the "natural history" of the human species. If our interest is in general psychology instead, we should be as concerned with the repertoire of any other redintegrative system—that of the earthworm, the guinea pig, or the rooster. It is not our purpose here to attempt any such inventory, either partial or complete.

Even if we should attempt such a natural history of man, the task would be thankless, for no one knows what human beings instinctively do. This is clearly revealed by a comparison of the various lists and descriptions of human instincts. From the moment of birth, human infants are taken in hand by managing adults who are stimulated by vigorous symbols of the "future welfare" of the child and of society. The very objects, implements, and other stimuli of the environment are vastly different from those to which his "instincts," if any, are presumably adapted by biological heritage. And the period of human infancy is so helpless and so prolonged that native proclivities become deeply buried under the garments of habit.

Of one thing we can be reasonably certain. This is that most of the "instincts" attributed to man are instead early acquired and well-nigh universally established habits. Thus it is often said that men instinctively seize, collect, hoard, and struggle to retain whatever they get their hands upon. This "collecting instinct," "native acquisitiveness," "property sense," "selfishness," and so on, is then cited as an inherited propensity upon which many social institutions are based.

While definite proof is lacking on one side as well as on the other, it seems reasonably clear that such human activities are not determined by the structure of the human creature. They are most of all dependent upon the character of the

world into which he is born. Suppose, for example, that instead of this world being characterized by a dearth of commodities, it were filled with everything that could be used or desired.

Babies "wanting" rattles, dolls, rubber balls, and wagons could then simply reach out into the air and take them or make a gesture and produce them. Suppose that every human, child or adult, could have all the apples, sweethearts, automobiles and steam-heated apartments on the Drive that he might *want*, merely by saying a magic word, which every one knew and could utter with entire freedom. Extend the option to anything else in any way usable or satisfying. It is inconceivable that in such a world anything like avarice, jealousy, greed, thrift, or envy should occur, or that such activities as hoarding, collecting, stealing, and deceiving should go on. But why not, if instinctive acts are due to inherited patterns of nervous connections which lead to set acts in the presence of stipulated objects?

Perhaps the answer will be ventured that such instincts would still exist but would not assert themselves because their stimuli did not occur. What then is the stimulus? Surely not the objects, such as rattles, apples, and yachts. And surely no temporal or spatial arrangement or configuration of such objects. No, the fact would be that the acts did not occur because there were no *wants*. But wants are facts which accrue to an individual by virtue of the kind of world into which he is born.

The so-called human instincts, at least, are in the main only learned techniques for the alleviation of such *wants*. They are habit devices for the elimination of annoyances, the satisfaction of cravings, in a world chiefly characterized by poverty of commodities. Fighting, hunting, courting, gregariousness, curiosity, and all the other honored "human instincts" seem similarly accountable. The wants we shall later consider again.

There remains only a group of activities which are what they are chiefly because of the organs or structures which they involve. Structures, as organic features, are lively and ani-

mated, restless and active. Having eyes, we see; having stomachs, we hunger; having reproductive apparatus, we mate; having legs or wings or fins or tails, we use them. In this sense the typical activities of any species, including man, are restricted by their structures. Such structurally determined activities may legitimately be called instincts. But these are not the human instincts on which traditional psychology has dilated. And the most conspicuous thing about man, aside from his use of language, is the way in which the hand is adaptable to any variety of acts, and extended into an instrument of almost any kind through the invention of tools.

The fact, of course, still remains that since the world is what it is, human beings will in common acquire many fundamental modes of characteristic activity. Since these are early and well-nigh universally acquired and become thoroughly mastered and amenable to many and subtle cues, they may be eradicated with difficulty or not at all. For education, management, industry, government, literature, and art such widespread habits will be of grave concern.

Applied psychology, in these fields, may be much occupied with the human inventory. When any animal trainer begins to specialize on one species, he will find it equally important to make such a list of the structures and habit forms of the species in question. We have even had occasion to suggest that the psychology of animal learning might have profited from preliminary accounts of the biography of its subjects.

Finally, it may be said that what is characteristic of human beings is that they *have* certain wants and come to supply these in their particular ways rather than otherwise. But the account of *human wants* is another matter than the enumeration of an array of human instinctive acts.

CHAPTER XVIII

EXPERIMENTS ON VERBAL ASSOCIATION, ON HABIT, AND ON INSTINCT

VERBAL ASSOCIATION

Under the heading "association of ideas," numerous investigations have been conducted on verbal association, in which a word (seen or heard or thought) instigates another word (spoken, written, or thought). Sometimes the interest has been in determining what words go together in this way, the laws of verbal association. Or verbal connections have been used merely as instruments in the study of learning, memory, imagination, intelligence, choice, and so on. Verbal associations have also been much used as means of observing the influence of various agents or conditions, such as fatigue, emotion, drugs, drowsiness. They have been employed as indirect means of revealing interests, attitudes, information, guilt, deception, and mental deterioration. Sometimes the verbal elements are studied in their own character, but more commonly the words are taken as symbols for the objects and situations which they represent, and the relations of these are considered. One or two examples will suffice to illustrate the general character of the association experiments.

A standard list of stimulus words being used, individuals may be compared in terms of the responses which they make to the separate words under the instructions "Speak the first word that comes to mind when you hear the stimulus word." Perhaps the simplest measure is the number of identical responses made by two subjects, in the course of one hundred stimulus words. This affords an indication of resemblance, which may be related to common interests, experience, preoccupation, and so on. The following table of typical results

shows the number of identical responses in the case of various pairs of college students. The measures do not, of course, explain the cause of the resemblances shown; they afford, however, a quantitative indication, and thus become useful aids in the further investigation of personality.

TABLE XIII

IDENTICAL RESPONSES IN THE CASE OF A LIST OF ONE HUNDRED STIMULUS WORDS (FREE ASSOCIATION)

Subjects	*Per Cent Identical*
F and P (twin sisters, in same college)	23
B and her sister B2	19
V and her mother	15
F and a fellow student, chosen at random	12
P and a fellow student, chosen at random	12
B and V (fellow students chosen at random)	5
B2 and V (not living in same city)	2

By a complication of this method, tables have been compiled showing all the responses to each stimulus word given by large numbers of adults and also of children. The individual's resemblance to the common trends may be measured in various ways by the use of such tables. Thus a "common response" may be considered any word that occurs in the group table; and the number of "common responses" given by a new individual may thus be determined. Idiosyncrasy in these respects will be shown by small percentages of common responses. High degrees of "community of ideas" will be shown by large frequencies instead.

COMMUNITY OF IDEAS

When the table of adult responses is used as the standard, the common responses given by children are found to increase in number with advancing age, up to about 11 years, where the figure reaches about 90 per cent, which is the usual figure for individual adults also. In groups of white and black children of varying ages, the degree of community, as thus

measured, was found to run consistently higher in the case of the former. The following table shows the results of such a study.[1]

TABLE XIV

COMMON ASSOCIATION RESPONSES BY WHITE AND NEGRO CHILDREN OF DIFFERENT AGES

(From Rosanoff)

Group Ages in Years	Common Responses by Children, in Per Cent	
	White	Black
4	41.5	38.5
5	57.1	42.9
6	64.9	54.3
7	68.9	59.7
8	74.2	64.7
9	80.6	68.8
10	81.3	74.4
11	89.1	81.8
12	90.4	81.7
13	89.5	81.4
14	90.4	85.0
15	86.3	82.5

In the case of children, the degree of commonness of such responses correlates positively with brightness as estimated by teachers, and also with school grades. But a series of studies by the writer shows that in the case of college students the reverse situation is the case. It is the duller pupils, by mental test, and those receiving lower college grades, that show the highest numbers of common responses, as compared with their college mates. The following table, from one of these studies, shows the typical results. The students are here classified first on the basis of their score in an intelligence test

[1] Mitchell, Rosanoff, and Rosanoff, "A Study of Association in Negro Children," *Psychological Review*, Vol. XXVI (September, 1919), p. 5. See also I. R. and A. J. Rosanoff, "A Study of Association in Children," *Psychological Bulletin*, Vol. XX (January, 1913), p. 1; and A. J. Rosanoff, "A Study of Association in Insanity," *American Journal of Insanity*, Vol. LXVII (Nos. 1, 2, 1910).

(lower quartile, middle 50 per cent, and upper quartile). Then various other scores for these groups are computed.[2]

TABLE XV

COMMON ASSOCIATION RESPONSES IN THE CASE OF COLLEGE STUDENTS, COMPARED WITH VARIOUS OTHER DATA

Measurements	Lowest Quartile	Middle 50 Per Cent	Highest Quartile
Language completion test (Trabue A, 4 minutes)	31.1	38.1	42.6
Grade in psychology	81.0	84.0	86.0
Memory span (digits)	6.2	7.1	7.6
Median of community	107.0	53.0	29.0
Per cent common responses	89.0	88.0	79.0
Banality index	40.3	36.8	28.1

ASSOCIATION CATEGORIES

In place of scoring responses according to the frequency with which they are given by others, the words themselves may be considered, their grammatical or logical relations to the stimulus words, or the relations between the objects denoted by the words. Such tables as that on the following page are much used for such classifications and analyses.[3]

Jung and others have described several "types" of reactors on the basis of such classifications. The results appear more clearly in naïve subjects not yet adapted to the experiment and uninformed as to its significance. The characteristic responses of different subjects are said to distinguish emotional state rather than intellectual types, attitude rather than capacity. Thus:

Educated test persons show superficial and linguistically deep-rooted associations, whereas the uneducated form more valuable asso-

[2] The last three measures of this table represent three different methods of computing tendency toward commonness of association response. In all cases the lower the figure the lower is the degree of community with the standard table for adults as given by Rosanoff.

[3] See, for example, F. L. Wells, "Practice Effects in Free Association," *American Journal of Psychology*, January, 1911.

TABLE XVI

Classification of Association Categories

(As adapted by F. L. Wells, after Jung and others.)

General Class	Category	Sample
Emotional	1. Failure of response	
	2. Egocentric	succeed—I must
	3. Egocentric predicate ...	lonesome—never
	4. Judgment of quality ...	rose—beautiful
Intellectual	5. Simple predicate	spinach—green
	6. Subject relation	dog—bite
	7. Object relation	deer—shoot
	8. Causality	joke—laughter
	9. Coördination	cow—horse
	10. Subordination	food—bread
	11. Supraordination	rat—animal
	12. Contrast	sunlight—shadow
	13. Coëxistence	engine—cars
	14. Identity	expensive—costly
Superficial	15. Speech habits	town—state
	16. Word compounding	side—board
	17. Rhyme	pack—tack
	18. Syntactic change	deep—depth

ciations and often of ingenious significance. This behavior would be paradoxical from an intellectual viewpoint. The meaningful associations of the uneducated are not really the product of intellectual thinking, but are simply the results of special emotional states. The whole thing is more important to the uneducated, his emotion is greater and for that reason he pays more attention to the experiment than does the educated person, and that is why his associations are more significant.[4]

The "types" that have been indicated are as follows. In the *objective* type the reactions are usual and undisturbed. In the *complex* type many disturbances are occasioned by special emotional complexes. A *definition* type is described which "consists in the fact that the reaction always gives an explanation or a definition of the content of the stimulus word." In

[4] C. G. Jung, "Studies in Association," *American Journal of Psychology,* 1910.

the type called *predicate*, it is not the intellectual but the emotional significance of the stimulus word that determines the response, and reaction words indicating strong personal evaluation occur.

The predicate type has also been called "egocentric." "The number of these 'egocentric' associations," says Wells, "has been thought, with reason, to bear a peculiar relation to the subject's general personality. In normal persons from fifteen to forty-five per cent of associative responses belong to this group. Single series have been taken with as low as two per cent and as high as sixty per cent; but the number of these is a fairly constant attribute of the individual."[5] Excessive egocentric responses are believed to indicate either a specific or a general maladjustment in the individual's affective or instinctive life and, therefore, to signify a lack of temperamental balance.

In similar ways the association test has been used by many investigators as giving a possible clue to temperamental traits: cheerfulness or gloominess, as indicated by the predominance of pleasantly or unpleasantly toned responses; objective attitude or introversion, as indicated by the relative numbers of common and individual responses; the relative strength of interests and instincts, as indicated by the speed of reaction to certain words, the vividness of certain responses, and other criteria.

MANUAL HABITS AND INTERFERENCE

The "association" studies, as we have seen, are essentially concerned with speech habits, the antecedent being one word, the consequent another word, the sequence often being determind in part by past contexts which these words "represent" or mean. Many studies have also been made of habits of other forms; in fact, most if not all of the studies of learning are concerned with habits. Next to speech, the use of the hand is a distinctively human feature, and training and habit

[5] F. L. Wells, *Mental Adjustments* (D. Appleton and Company, 1917), pp. 261*ff*.

formation in the use of the hand are a prominent part of human education. Illustrative cases of the study of manual habits may be cited in connection with the phenomenon of *interference.*

In response to a given cue or stimulus two incompatible responses may have been independently established. The problem then is what will occur as the consequent on a subsequent occasion. In the case of certain reflexes various relations of antagonism, inhibition, and reënforcement are constitutionally present. A number of investigations have studied the results in the case of habits also, of a simple sort. Muensterberg early raised the question of interference, by inquiring whether, when two responses were attached to a stimulus, both would occur, or whether they would interfere, or whether one would have right of way.

He experimented by carrying his watch in one pocket for a long time, then shifting it to another pocket and noting the number of errors made. Then he shifted it back again and for another month watched the results. He found that false movements would be made but that the old habit was more quickly learned again than the new one had been acquired. He concluded that some effects of the old habit, therefore, remained. After three such changes no errors occurred; either one or the other habit functioned, depending on the circumstances. Similar experiments were performed with the doors of his room and with the inkwell. Since these early observations, many more elaborate studies have been made (Bergstrom, Bair, Culler, Brown, Jersild), investigating such questions as the following: How does the number of repetitions affect the degree of interference of two habits? How does this vary with the stage of practice? How is learning capacity related to tendency to show interference, in different individuals? How does tendency to show such interference correlate with other traits of individuals?

One investigator[6] had different squads of people sort cards

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[6] A. J. Culler, "Interference and Adaptability," *Archives of Psychology,* No. 24 (1912).

according to various plans, all involving, however, the shift from one plan of sorting to another plan. The following table shows the comparative results from four different squads. In all but one squad the first trial with a new arrangement was interfered with by having practiced a former arrangement, the arrangements, however, being of equal initial difficulty. The single exception is the squad that practiced the first arrangement forty-eight times before shifting to a new one. Here there was not only no interference, but a positive gain (transfer) when the new arrangement was attempted; it was now accomplished more quickly than the first arrangement had been in the beginning.

TABLE XVII

INTERFERENCE IN CARD SORTING

(From Culler)

	Time in Seconds for A 1st Trial	Time in Seconds for B 1st Trial	Amount of Interference, in Seconds
Group sorting Method A *once*, then immediately sorting by Method B	112	117	5
Group sorting Method A *four times*, then turning to Method B............	116	125	9
Group sorting Method A *eight times*, then turning to Method B............	97	101	4
Group sorting Method A *48 times*, then sorting by Method B............	119	114	Gain 5

If such shiftings are continued, both methods come in time to be perfected, and then neither interferes with the other. And if one method is perfected before the other is attempted, there is seen to be no interference. The conclusion is that rival or incompatible manual habits, in response to visual clues, interfere with each other so long as neither is perfected. But as each becomes established, no measurable amount of interference is found. It is in this way that we

may learn two languages or two systems of shorthand, turning freely from one to the other. But until one of them is perfected, its performance is a positive detriment to the exercise of the other.

Both Culler and Warner Brown[7] have tried to discover just what type of person is most likely to show such habit interference, or show it in greatest degree. Brown showed that those who suffer most from interference in card sorting were those who were the best learners in that process. Especially liable to interference was "that rare combination, a fast worker and good learner." This is in changing from the old to a new order; in shifting back from the new to the former order, the reverse was found to be the case.

Culler measured amount of interference on several subjects both in typewriting and in a reading process (eight subjects). These subjects were then independently rated by ten acquaintances for the traits originality, individuality, and independence. The various measures were then correlated or compared. Those who suffered most interference in typewriting did also in the reading process. The other correlations were negative; those who suffiered the most interference were usually rated low in the three estimated traits. Such results, on small numbers of subjects, are far from conclusive, but they serve to illustrate the phenomena of habit interference, the fact of individual differences therein, and suggest the possibility of finding definite relationships between such features and other important character traits.

THE NATURE OF INTERFERENCE

It would be, however, a mistake to suppose that the facts of interference of habits imply any strange phenomenon in the nervous system or elsewhere. The key to the facts seems to be contained in Brown's observation that interference is more apt to appear (in card sorting) in the case of good

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[7] Warner Brown, "Habit Interference in Sorting Cards," *University of California Publications in Psychology*, Vol. I (April 24, 1914), p. 4.

learners. We have again the simple facts observed in connection with the problem of transfer in the chapter on learning. *What has been learned may be used.* If two incompatible habits have been acquired, the wrong one is likely to assert itself on a given occasion, and this impedes adjustment. Or if habits have been established in one connection, they are likely to assert themselves in another connection if the same stimulus appears. If nothing had been learned there could be no interference. When the interference disappears as both processes are perfected, this means only that slight accessory cues, acting as keys to the respective situations, have now become potent in determining the response in each case, in coöperation with the primary stimulus.

Transfer and interference have been studied also in the case of habits of lower animals. Hunter found that untrained pigeons learned a maze more competently than did pigeons previously trained on a different maze. Yoakum showed that squirrels trained to open two boxes learned a third less easily than did squirrels with no training. Acts learned in the first two boxes were of no use in the third, yet they tended to occur in response to the general situation, with consequent loss of time. In other cases, instead, the learning of certain labyrinths or boxes has facilitated the subsequent learning of others, as in the case of rats (Richardson) and dancing mice (Yerkes). The problems of transfer and interference seem then to be essentially the single problem of the relevance of what has been previously learned, when it occurs on later occasions.

EXPERIMENTS ON INSTINCT

Experimental studies relating to instinct are rare, since native tendencies and modes of response, even in simple animals, are early complicated by the facts of learning. The investigation of instinct is then usually a matter of general observation and inference, rather than of experiment in the true sense. In the case of human beings we can list only the simple observations of reflexes and vague emotional patterns of behavior. These we have already noted. In 1914,

a comparative psychologist reviewing the "results of the experimental study of instincts" enumerated these under the following heads:

1. Initial performance of some instinctive acts.
2. Serial unfolding of instinctive repertoire of animals (guinea pig, rat, monkey, sooty tern).
3. Quantitative study of improvement of instinctive functions.
4. Modification of instinct by means of social influences.
5. Hereditary character of certain instinctive traits.
6. Waning of instinct; loss through disuse; etc.[8]

Subsequent years have reduced rather than added to these "accomplishments," through the development of more rigorous criteria of "experiment" and through the general overhauling of the concept of instinct. Even the results indicated were so scanty as to jeopardize the topic under which they were aligned. Brief accounts of some of these experiments will, however, serve to indicate the attempts made to submit native repertoire to experiment.

Two experiments, by Berry and by Yerkes and Bloomfield, undertook to ascertain whether cats instinctively chase mice. The first concluded that this is not the case, though kittens may instinctively pursue any moving object, and that they learned to catch and kill mice by imitating older cats. The second, on the contrary, concluded that the instinct definitely appears during the second or sometimes the first month. It is suggested that in the earlier experiment the kittens were too old, and that the instinct had waned through disuse.

Several accounts have been recorded [9] of the definite, predictable, and fairly complex way in which the young bird pecks its way out of the shell, for the first and last time. But no experimental controls have been introduced, hence little is known beyond the familiar observations that this feat is accomplished.

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[8] J. B. Watson, *Behavior: An Introduction to Comparative Psychology* (Henry Holt & Company, 1914).

[9] As by W. Craig, "Behavior of Young Birds in Breaking out of the Egg, *Journal of Animal Behavior,* Vol. II (1913).

Studies have also been made of the accuracy with which newly hatched chicks peck at, secure, and swallow small grains of food. Thus Breed showed that the success of this pecking reaction increases rapidly up to about the tenth day.[10] When pecking was experimentally prevented for the first few days, the pecking, when at last permitted, was inferior to that exhibited by those allowed to peck from the start. Chicks not allowed to peck for five days then began with an accuracy no greater than that of the ordinary day-old chick. But in two days' practice they were able to perform as well as their unhandicapped mates. The inference is that the change in accuracy comes from learning rather than from mere maturation of the mechanisms involved in an instinctive act. However, the rôle of maturation and learning in the development of animal behavior is still in many respects doubtful.

Experiments of Scott[11] and of Conradi[12] on the singing of birds of various species are classical in this field. The former isolated, for several years, orioles which had never heard any of the songs of their species. They developed a song of their own that had in it but little of the familiar oriole character. Young birds put in with a pair of these adults sang at the usual time, producing the song of their adult associates, the atypical oriole song. Various other observations, as on robins, thrushes, catbirds, blackbirds, and others, brought up together, were also reported.

Conradi reared sparrows with canaries. The cries of the sparrows deviated markedly from the ordinary sparrow chirp, tending toward but never attaining the canary song. Removed to the company of other sparrows, they speedily lost the canary notes and chirped like sparrows, but somewhat more musically. The intimation is that at least the form of bird song is much

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[10] F. Breed, "The Development of Certain Instincts and Habits in Chicks," *Behavior Monographs*, No. I; also Breed and Shepard, "Maturation and Use in the Development of an Instinct," *Journal of Animal Behavior*, Vol. III (1913).

[11] W. E. D. Scott, "Song in Birds," etc., *Science*, Vols. XIV (1901), XV (1902), XIX (1904).

[12] E. Conradi, "Song and Call Notes of English Sparrows When Reared by Canaries," *American Journal of Psychology*, Vol. XVI (1905).

influenced by the sounds made by asssociates, some species being more susceptible in this respect than others. But song of some kind seems spontaneously to occur.

These much-quoted experimental studies of animal instincts do not exhaust the list, but they serve to indicate the problematic character of the whole concept of instinct. They suggest, also, some of the difficulties of putting the topic on an experimental basis, especially in the case of the higher animals, with their greater aptitude for learning and their more complicated repertoire of action.

CHAPTER XIX

CRAVING, FEELING, AND EMOTION

LOCALIZED CRAVINGS

Special psychological importance attaches to those patterns of observed quality that are referred to the organism of the reporter. Because of their relative simplicity and lack of coherent organization, these are often called organic sensations and bodily feelings. They comprise a large field of natural events, directly accessible only to the subject. They are, therefore, extremely private and subjective in character, yet they play a conspicuous rôle in mental life. Their range in quality, variety, and degree of complexity is very great. They enter into complex fusions and patterns of which the elements or constituents are often not easily identifiable nor readily namable. We may best approach them and exhibit their importance by beginning with the simpler and more definitely localizable forms.

First may be enumerated such events as ache, pain, nausea, itch, tickle, strain, tension, stiffness, hunger, thirst, cramp, soreness, repletion. These are patterns of attribute and quality, definitely structured or markedly processual, with characteristic temporal organization and with rather clearly discernible spatial character. They are closely correlated with what we know in visual and tactile terms as the bodily tissues. In the course of learning they come to be definitely localized in parts of the body. Thus the ache is found to be associated with or located in tooth, toe, or ear. Each of these types of object comprises a considerable array of subforms, degrees, and varieties. Thus pains differ widely among themselves, although adequate classifications and analyses of such events are not yet available. We can only roughly localize the vari-

ous pains that occur, indicate their duration and intensity, apply such qualitative or intensive terms as stabbing, throbbing, sharp, dull, and the like, and roughly describe their course of change. We cannot even state confidently what "neural structures" are correlated with pain, nor, in detail, the nature of the antecedents or stimuli.

Such events are of special importance for two reasons. In the first place, they tend to be relatively persistent and enduring. A tactual object on the surface of the skin may be easily brushed away; visual objects may be at least temporarily "dismissed" by merely closing the eyes; we can avoid sounds by departing from their "vicinity." But the correlated conditions of these organic patterns are often changeable only with difficulty; they follow wherever we go. Such persistent and omnipresent patterns as ache, pain, nausea, hunger, strain, and the like, therefore, readily play the rôle of *motives*.

In the second place, these patterns of organic sensation are commonly associated with bodily conditions inimical to the health of the individual. They accompany extreme degrees of activity and stress, injury to tissues, nutritive or respiratory deficiency, local conditions of disease or infection, and so on. Not only are they annoyances and distractions in the normal course of other activities, into which they intrude. They also represent conditions and antecedents that have some ominous or significant bearing on the vital welfare of the organism or of its special structures.

In some cases, as in nausea, reflex acts are automatically provoked. Vomiting is a mechanism which even in infants serves directly to contribute toward alleviation of the stimulus which prompts it. Superficial itch and tickle soon come to lead to retouching movements or pressure, rubbing and massage, which afford "relief." Distension of bladder and colon are followed by the reflex adjustments of elimination. The oppressiveness of suffocation leads to vigorous struggling and gasping, which tend under simple conditions to allay the influences which provoke them.

These masses of "organic sensation" may, therefore, appropriately be called *cravings* or irritants. In their persistence

they lead to various modes of adaptation, either natively or through learning, calculated to annul them. They may not be accompanied by any symbolic representation of the technique of alleviation, although often such a symbol is their very first consequent. In such cases the term "craving" is even popularly applied. Thus hunger and thirst are recognized as *cravings for* definite adjustments. But even when there is no such representation, by a symbol, of the native or learned technique of alleviation, these patterns are, nevertheless, cravings. They are conditions which persist, with disruptive effect on other sequences, until they are satisfied or removed.

Such cravings are commonly classed as sensory qualities, along with qualities from the "higher senses," such as sight and sound. This is because they are usually localizable and correlated with special structures in the visual-tactile field, known as sense organs, sensory nerve endings, or receptors. But as we have seen, this correlation is in most cases still conjectural. Such complexes are, however, at least usually directly referable to particular tissues, structures, organs, or regions of the body. Their immediate correlates may in some cases be found to be only changes in the neural system itself, with no distinct reference to peripheral modes of stimulation or general somatic processes.[1]

GENERAL BODILY FEELINGS

In a rather different class belong the general "bodily feelings," such as fatigue, effort, sleepiness, loathing, excitement, feverishneses, liveliness, restlessness, animation, chill, shiver, ennui, relaxation, calm, clumsiness, exhilaration, familiarity, strangeness, irritation, amusement. Some of these closely resemble the organic sensations or localized cravings. They definitely refer to the condition of the body and its parts, but are more diffuse and general in their localization.

[1] See Appendix I for tentative lists of the elementary cravings and desires.

This is the case, for example, with fatigue, excitement, feverishness, ennui, sleepiness, agitation.

Some of these bodily feelings are referred particularly to the musculature. They are patterns of kinæsthesis rather than of visceral and organic quality. This is the case, for example, with restlessness, relaxation, effort, liveliness, and animation. Still others refer more particularly to the way in which motor activities as a whole go on. Or they refer to the course of symbolic activities such as those employed in thought and in social communication. Thus speech, facial expression, and gesticulation are closely involved in animation, familiarity, amusement, and strangeness. Such feelings thus seem to reflect not so much the general vital or vegetative condition but rather the degree of freedom, ease, and harmony of motor activity and of symbolization or thought.

It has also been suggested that such experiences as pleasantness, unpleasantness, excitement, calm, strain, and relaxation constitute a special class of events, to be known as "affects" or "affective elements." Some psychologists make this claim only for pleasantness and unpleasantness. The chief reasons suggested for distinguishing the affective elements from sensory qualities is that they are unlocalizable, do not clearly depend on special sensory end organs, and tend to vanish if closely scrutinized.

In the first case, it must be pointed out that pleasantness and unpleasantness and the like qualities are often as definitely localized as are other qualities, such as odors. Moreover, such qualities often appear as direct constituents of an elaborate object or pattern, as a picture, a food, or a melody. The pleasantness of the melody is where the melody is, and is localizable in the same sense. The unpleasantness of a toothache seems definitely localized, not diffused throughout nature.

On the second point, we have already intimated that not only are the sensory end organs for various organic sensations (as pain, for example) not demonstrated, but suggestions have been made that special nerve endings, such as those of the genital tract, underlie pleasantness in general. Hence the

distinction between affective and sensory qualities on this ground is at least insecure.

As for the fact that attention to such feelings tends to diminish rather than to enhance their vividness, this is often merely because the feelings themselves are the consequents of other stimuli currently active, and which are eliminated by the shift of attention. And in the case of many unpleasantnesses the account is entirely incorrect.

The most we can say is that such namable qualities as these bodily feelings occur. The problem of their various correlated events (as their neural accompaniments) is still a matter for investigation. This is the case not only with the supposed affective qualities but also with such feelings as sleepiness, amusement, liveliness, and ennui.

In general, then, these bodily feelings reflect the course of current activity, vital, motor, or symbolic. Interference with activities definitely under way, at the instigation of other stimuli, is often an adequate stimulus for their appearance. General circumstances and settings hostile to the momentary trend and course of action or of thought are similarly effective excitants of many such feelings. Or general bodily conditions are reflected which have some definite influence on the organization and compatibility of local stimuli and their wonted consequents.

Such bodily feelings lead also, either natively (as in sleepiness) or through learning (as in ennui), to acts calculated to alleviate them. The fatigued rest; the sleepy retire; the bored seek for change; the restless engage in chatter, work, or play. Many of these feelings thus serve as *motives*. They lead, in general, to consequents which will serve to eliminate them.

Any thwarting of current trends of action is likely to arouse such feelings and to lead in turn to acts which either stupidly or intelligently persist until the impediment to free action is abolished or reduced. If such freedom is not secured the motive persists, intensifies, spreads. Even when "worn out" through exhaustion or adaptation, it persists, perhaps in symbolic or partial form. It thus constitutes a lasting deter-

minant or influence on the effect of other stimuli and on the organization of other acts. It may arouse symbols for techniques of alleviation and thus be transformed from a mere persistent motive into a fixed purpose.

It is characteristic of such feelings that they obtrude little of their qualitative character. We use them chiefly as signs of the circumstances under which they arise, or as indexes of the acts which will alleviate them. They are most of all consequents of vital stimuli and cues to vital consequents. This is the chief reason why activity directed toward them (as in naming and analyzing), rather than toward their stimuli, often causes them to vanish. Hence accurate and detailed description of such events lags far behind the functional account of their hygiene, prevention, and therapy.

Careful introspection can analyze ennui, for example, into varied components which on a given occasion comprise it. But in ordinary life we are satisfied with a single name for the experience as a whole. The feeling is a middle term which serves to lead from its stimulating antecedent to a further consequent or adjustment. We have no interest in identifying, naming, and measuring the particular and specific strains, stresses, organic, visceral, and kinæsthetic elements or qualities which comprise it. The subjective character of such events, and the difficulty and reluctance of experimentally producing them, work in the same direction. The descriptive psychology of such feelings is, therefore, at present woefully inadequate.

THE HIGHER OR INTELLECTUAL FEELINGS

The same thing is to be said of another group of processes often called the "intellectual feelings." They are illustrated by such names as doubt, anxiety, confidence, expectation, congruity, harmony, assent, disagreement, disappointment, surprise, conviction, assurance, curiosity, wonder. Here, also, if one is asked to "describe the feeling" the reply is likely to be an indication of the circumstances under which the feeling arises, or of the consequent to which it leads. So inveterate is this tendency to name the circumstances, to indicate the

meaning, of feelings, that many have assumed them to be unique and unanalyzable entities. Thus in recent years such feelings have been called "conscious attitudes," much as if consciousness were an actor, capable of posture and gesture.

Such feelings, to be understood, should be carefully regarded before they have become reduced and attenuated cues to further activity. When thus considered they appear as extremely complex processes, often rapidly shifting and changing. They involve usually recognizable patterns of kinæsthesis, relaxation, contraction, set or rhythmical play of muscles, such as those of eyes, face, back, neck, and hands.

They often involve vaguely localizable or diffuse organic components, correlated, for example, with changes in pulse, breathing, general bodily tonus, visceral tensions, glandular activity. They are definitely colored also by such equivocal constituents or qualities as pleasantness, strain, relief. They involve also characteristic course of other events, such as flow or arrest of speech, variety or dearth of imagery, rapidity of succession of various symbolic items. Sometimes this course is one of smooth and easy flow; again that of turbulence and irregularity.

Such feelings involve especially, and perhaps most importantly, the various *relations* of such processes. Thus relations of gesture stand out as signs of other relations in other fields of observation. The felt conflict of motor sets and postures may signify spatial, logical, social, or other modes of incompatibility. The spatial relations and behavior of imagery represent the conduct and status of other events, the existence of alternatives, the readiness or loss of adjustment, the answers to questions. Thus our judgments of the objective weights of two things depend on, and are rendered in terms of, the relations between our lifting movements, and the features of maintenance and shift in the motor sets with which we handle them.

In anxiety, for example, all these components are often discernible. There is a fairly definite posture and facial expression, which we recognize visually even in the photograph, and which the subject knows in terms of kinæsthesis. There

is general tightening and tension, a reduction of bodily tonus, a slowing up of vital activities, such as pulse and glandular secretion, or perhaps other irregularities instead. Unpleasantness and strain are essential parts of the pattern. Speech is retarded, facial expression is set and constrained. Particular images, words, or other symbols characteristically perseverate or are renewed. Automatic acts occur, such as frowning, rubbing the eyes, wringing the hands.

The interrelations of all these constitute the symbolic representation of feared calamities, accidents, or outcomes. The flow of thought is characteristically arrested or impeded, and particular motives and purposes dominate the general course of conversation, dream, imagery, thought, and movement. Special forms of action, such as play, laughter, song, are impeded, and skilled acts of any sort may be incoördinated and disorganized. Anxiety is, therefore, more than a bodily attitude; it is this and more. It is a characteristic course and pattern of subjective events, complex, variable, and multiform, correlated with varied objective manifestations as well.

The particular structure of anxiety, to continue our example, will vary with numerous details, such as the provocative stimulus, the duration of the occurrence, the personality of the subject, his past history, present concurrent contexts, and especially with the available repertoire of techniques of alleviation and the readiness and mode of their symbolization. To describe an anxiety in general is, therefore, like describing clouds in the abstract. No two clouds are quite alike, nor any two anxieties. But there is present, we may suppose, a certain common core or pattern which serves to differentiate anxiety from other intellectual feelings.

We do not know how much of this differentiating feature lies in the organic and kinæsthetic components, and how much in other aspects of the picture. Our identification of such feelings, in ourselves and in others, is often clearly dependent on the visually perceived or verbally described situation in which they occur. On the other hand, in certain pathological conditions, the feeling seems to arise in ways not obviously related to current stimuli that are observable. A satisfactory

stimulus is then "sought for" by the patient, who searches for some fact in nature which will explain or excuse the feeling. Chronic depressions, due to antecedents for the time being not identified, thus lead to rationalization and even to delusional interpretation.

ANALYSIS OF INTELLECTUAL FEELINGS

It has been forcefully urged that patterns, fusions, sets, shifts, and variations in kinæsthesis largely constitute the intellectual feelings, especially in combination with organic sensation. Thus Titchener maintains that the imageless thoughts, the awarenesses, the conscious attitudes, are actual attitudinal feels, roughly describable as visceral pressure, distributions of tonicity in the musculature, sensed variations in the play of facial expression, and similar organic and kinæsthetic patterns. We may quote typical suggestions to this effect from Washburn who supposes that the more readily namable such an intellectual feeling is "the more it tends to have a kinæsthetic basis; the less readily namable it is, the more it involves processes of other modalities." The various intellectual feelings are, therefore, described as fusions, patterns, or shifts of kinæsthesis. These are sometimes neatly localizable and recognizable, in which case they are commonly classed as kinæsthetic sensation. Or they are more diffuse, variable, inconstant, tentative, and reduced, developing into identifiable kinæsthetic constituents only when long sustained. Thus:

> The commonest and functionally the most fundamental of all these motor responses accompanying certain happenings in the interaction of movement systems is that which apparently may accompany any *sudden shift* of motor excitation, provided that attention is directed to the relational or kinesthetic aspect of the process. . . . The consciousness accompanying a sudden shift of motor excitation is the feeling or awareness of *difference*. . . . This shift is the cue for giving the verbal response "different."[3]

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[3] M. F. Washburn, *Movement and Mental Imagery* (Houghton Mifflin Company, 1916), pp. 199, 200.

Again:

Expectation in even its lesser degrees is based on a bodily attitude that allows of considerable analysis. It very clearly involves for introspection a certain static attitude, giving rise to strain sensations; in fact we commonly speak of strained expectation. This attitude is modified according as the expectation is wholly indefinite, wholly definite, or partially determined. We may be, that is, in a state of expectation of we know not what; or we may expect a particular something; or we may expect one of several definite possibilities. When expectation is wholly indefinite it would not seem to differ from the attitude of strained attention, of being on the alert. When it is absolutely definite, along with the attitude of strain there are already excited the tentative movements which are the specific response to the stimulus awaited: thus if we are waiting for the waving of a white flag as a signal, we are already making responsive movements proper to that stimulus, such, for instance, as saying "white" to ourselves. These tentative movements may or may not be accompanied by an image of the object looked for. If, in the third place, expectation is of several possibilities, there is infused into the attitude of strain an attitude of hesitation or doubt. This attitude occurs whenever a certain movement system suggests incompatible movements alternately; we waver between the different possibilities.[3]

We present finally the somewhat briefer analysis of "the feeling of '*but*'." This is a feeling which in its ordinary transient occurrence is with difficulty analyzable, but it naturally, or if prolonged, develops into attitudes that are namable.

It resembles the "feeling of difference" in not involving any expectation, and the experience of incorrectness in being capable of developing into a more marked and generalized disturbance than the experience of difference can evolve. It would seem to occur whenever two movement systems, developing simultaneously and on the basis of associative dispositions connecting them with each other, reach the point where dispositions of equal strength tend to excite incompatible movements. This occurrence appears to give rise to a definite and characteristic motor disturbance, in its lighter degrees reflected in consciousness as the "feeling of but"; in its more developed and diffused state becoming the disagreeable conscious attitude of puzzle or confusion.[4]

[3] *Ibid.*, p. 201.
[4] *Ibid.*, pp. 202, 203.

It would, of course, be a mistake to suppose that all relations are reducible to kinæsthetic and organic relations. Relations are encountered in all the fields of observation, but in the "higher sense" fields they are described as relations, patterns, situations of the materials or qualities involved. Distinctions are here often also closely made between the elements or fundaments, the relations, and the patterns or structures. The important point is simply that relations also exist among these organic and kinæsthetic qualities, and such relations and structures or processes are commonly and very roughly designated as "feelings." They are essentially disturbances of organic and kinæsthetic equilibruim.

THE PROBLEMATIC CHARACTER OF EMOTIONS

Among the traditional topics of psychology, that of emotion offers the greatest descriptive and systematic difficulty. The reason for this is chiefly the ambiguous psychophysical status of such events as these. Their place in the continuum of nature is equivocal, and psychology vacillates between objective and subjective accounts of them.

On the one hand, emotions are described as particular modes of animal behavior. In this sense they are objective events which any observer can report, and on which consistency of testimony is possible. An enraged dog, a frightened bird, an excited child, are often easily recognizable. They act in special ways, to which we give the name emotional. The emotions are changes in their visceral, somatic, and neuromuscular arrangements, and can, in part at least, be recorded by such instruments as galvanometer, plethysmograph, camera. If we also know something of the antecedent or subsequent circumstances, we may with considerable uniformity specify the particular emotion, as rage, fear, jealousy, and so on.

On the other hand, emotions may be described as "states of mind," "modes of consciousness," "inner feelings," or "experiences" of the subject who is concerned. Under this point of view, there are several rather different conceptions. Thus by an emotional state of mind may be meant an occasion in which

mental "contents," such as images, ideas, thoughts, and purposes, occur in disturbed or disorganized fashion. Or it may be meant, instead, that special *kinds* of "content" or subjective events occur, such as feelings, affective elements, moods. As subjective, such events are extremely private; they are directly accessible only to the individual who *has* them, in whose subjective world they happen. On this basis the only approach to the study of emotion would be that of introspection, or self-observation. Self-observation in this sense is, of course, only the scrutiny of those objects to which one alone has access.

There are also various combinations of these points of view, and modifications of them. Thus the peculiar objective behavior has been considered the "outward expression" of inner feelings. The behavior acts are then variously supposed to be either: (*a*) a set of acts which the inner feeling prompts, or (*b*) which in their occurrence relieve the inner feeling, or (*c*) which may merely be used by the observer as the natural signs of the otherwise unreported occurrence of such feelings. Or again, the emotions are described as closely linked with the "instincts," and to constitute their "affective aspect."

The nature of such affects (feelings and emotions) is also variously conceived. Thus they have been considered (*a*) as wholly mysterious affections of the soul; (*b*) as vague complexes of visceral, organic, and kinæsthetic quality; (*c*) unique modifications of consciousness correlated with general features and interrelations of neural processes or with the nutritive and other vital conditions of the body; (*d*) types of awareness occompanying activity of special neural regions (thalamus, autonomic nervous system); (*e*) as attributes (tone) of other objects (sensations) along with such attributes as intensity, duration, spread, and the like; (*f*) as a special set of vaguely defined and unanalyzed sensory qualities originating in the reproductive system and the genital tract; (*g*) as composed of primitive and undifferentiated "qualities," the genetic matrix of "sensibility," from which have evolved such "special sensations" as temperature, color, and the like; (*h*) as qualities arising from the relations of reënforcement, facilita-

tion, inhibition, and interference of nervous impulses; or (*i*) some combination of these and other accounts is suggested.

The variety of these accounts strongly suggests that the psychology of feeling and emotion still moves on a speculative plane. Such conjectural enterprises may be valuable for the direction of future inquiry, and for the setting of experiments. But the present enterprise requires us to keep as close as possible to such descriptive facts as are available. Our difficulty will be, not that such facts are few, but that they are so complex and varied as to "beggar description." We shall find it as impossible to inventory the emotional life of man as it is to enumerate all his habits, possessions, words, and purposes. At present, the safest way to describe a particular emotion is by indicating in detail the situation which provokes it. This is much like describing a plant or animal by indicating the geographical region which is its usual habitat. It is somewhat better than this, in that the descriptive words, as surrogates for the actual situation, tend to arouse corresponding emotions in the listener or reader. Literature abounds in this type of emotional portrayal.

SOME GENERAL CONSIDERATIONS

Several general points may first be noted. We can best approach the psychology of emotion by considering first the more impressive, striking, and violent emotional occurrences. For emotions, however described, undergo that course of reduction and transfer which makes also the analysis of habit, imagination, and motivation so baffling. The way is somewhat prepared for us by our examination of the organic cravings and the bodily and intellectual feelings. In some respects the emotions are only more violent, complex, and enduring patterns of the same general mode as these. They are like them also in being dominant cravings, demanding or leading urgently to their own elimination. They play a large part in the motivation of men and animals, as do also these simpler cravings and disturbances of equilibruim.

And we can best begin our description, when we are ready

for that venture, with the earlier manifestations of emotion. For emotions, also, come in time to reflect the whole previous history of the system in which they occur. We may note, moreover, how completely the field of an emotion coincides with that of an observation. If we consider emotions as characteristic activities of an organism, we find that the whole creature participates in such conduct, in a degree not found in such activities as reflexes, habits, imagination, and perception. An emotion, objectively considered, involves changes throughout the system to which it is attributed. A genuinely angry dog is "mad all over"; one "bubbles over" with excitement; is "overcome with depression"; "collapses" with fright; and joy is "unconfined."

In the same way, the so-called "major emotions," when introspectively regarded, involve the whole field of report. To the intimidated, all things are fearful; in joy the very landscape brightens; in gloom the universe threatens to totter and tumble about us; the enraged man pitifully pleads that "he didn't know what he was doing." Emotions, objectively attributed to an organism, involve the whole animal. Emotions, subjectively reported, color the whole field of observation. We begin to see at once, therefore, reasons why feeling and emotion are such tangled psychological topics.

RELATIONS OF EMOTION AND INSTINCT

Much has been made of the close connection of the two topics, instinct and emotion. As James clearly showed:

> Instinctive reactions and emotional expressions thus shade perceptibly into each other. Every object that excites an instinct excites an emotion as well. Emotions, however, fall short of instincts, in that the emotional reaction usually terminates in the subject's own body, whilst the instinctive reaction is apt to go further and enter into practical relations with the exciting object.

Objectively viewed, an animal may respond to a stimulus in either an organized or a diffuse manner. In the former case, the stimulus (say a loud noise) leads to specific and relatively

limited acts, which often have some obvious utility. The animal raises its head, pricks up its ears, looks about, and stiffens its body in preparation for overt action. These may be considered instinctive (native) defensive acts. Or in the latter case, that of diffuse action, movements are disorganized and widespread, often with no obvious utility and often damaging to the welfare of the individual. Thus the frightened animal may, in response to the loud sound, tremble, whine, palpitate, run frantically about, lose excretory control, or simply collapse. Such apparently futile acts also appear to be in large part natively determined. But they represent the failure of immediately adaptive movements, and as James noted, "usually terminate in the subject's own body." They do not "enter into practical relations with the exciting object." Such objectively observable breakdowns in adaptive behavior are called emotional. The organism is thrown into a commotional state instead of into organized patterns of adjustment, native or acquired.

Careful observation shows that many minute internal changes also participate in such breakdowns of preparedness. The autonomic nervous system is aroused and varied changes occur in structures and processes not under voluntary control. General muscular tonus changes; breathing varies in rate and depth as well as in regularity; circulatory processes are modified, as in pulse rate, blood pressure, and distribution. Glandular secretion is strikingly altered, both in the case of internal or ductless glands (as thyroid and adrenal) and in the duct glands (as the salivary and sweat glands). Unwonted spasms and contractures of the musculature occur. Speech is disturbed and facial expression characteristically changes. Learned acts may be increased in vigor or reduced or disorganized and thrown into confusion. Carefully rehearsed plans may fail of execution.

If the condition is prolonged, deep-seated and enduring changes may result. Glandular products (as adrenalin) poured into the blood stream may profoundly affect the biochemical processes of the body. The disturbance of glandular and circulatory equilibruim may impair or heighten such pro-

cesses as digestion and metabolism, and variously disrupt the established system of bodily economy.

GENETIC ACCOUNTS OF EMOTION

Various genetic accounts have been offered of the biology of such diffuse bodily states. Thus Darwin sought to show that in the lower animals many of these changes have a genuine utility. Exposing the fangs, stiffening the back, uttering wild sounds, play a useful rôle in animal combat. Cannon has sought to show the "emergency value" of the more obscure inner changes. Thus the heightened adrenal secretion results in release of blood sugar stored in the liver and consumed in the muscles during violent activity. Likewise, muscular tonus and liveliness are quickened; the circulation is shifted from the visceral regions to the extremities; the blood more easily coagulates in case of injury. The inner bodily changes are thus exhibited as the mobilization of the resources of the organism in occasions of rage, fear, pain, and effort.

In the case of human beings, in a high state of social control, most of these changes are only hereditary vestiges of adjustments with primitive utility. Social control tends constantly and increasingly to substitute group action for the emergency behavior of the individual, and even to prohibit the latter, or compel it to devious courses.

Men fight no longer with their teeth, and facial expressions of horror and shouts of rage do not dismay one's political opponents. Facial expressions, now vestigial, survive chiefly as a useful set of signs for social perception in cases of relatively mild clash and encounter. The profound inner changes as often interfere with civilized conduct as they perhaps assisted in savage life. They must now be controlled and guided, attached to serviceable situations, or they impede rather than reënforce our efforts. In football and war, and perhaps in public speaking, their old usefulness is restored. Otherwise these profound inner and biochemical changes are more likely to result in chronic conditions of tension, stress, and nervous breakdown.

COMPLICATIONS OF EMOTION BY LEARNING

When such emotional activities occur in adult human beings, they are much complicated by the learned acts and habits which have also been acquired with the situations which prompt them. In mild cases, indeed, the most obvious emotional effect is simply a modification of the speed, strength, or smoothness of organization of such habits. One gesticulates, walks, talks, or works on a modified level; more vigorously, with less animation, or with incoördination.

In other cases, to the native pattern there is added a group of movements of the learned sort. These are directed more or less definitely toward the stimulus. Or there are varied instinctive acts, with specific "external reference" imposed upon the emotional pattern. The following description of "hatred," from Mantegazza, shows clearly the joint presence of (*a*) diffuse internal bodily changes, (*b*) disorganized movements of the body and the extremities, (*c*) instinctive defense or attack movements, and (*d*) elements or patterns of habit.

> Withdrawal of the head backwards, withdrawal of the trunk; projection forwards of the hands, as if to defend one's self against the hated object; contraction or closure of the eyes; elevation of the upper lip and closure of the nose,—these are all elementary movements of turning away.
>
> Next threatening movements, as: intense frowning; eyes wide open; display of teeth; grinding teeth and contracting jaws; opened mouth with tongue advanced; clenched fists; threatening action of arms; stamping with the feet; deep inspirations—panting; growling and various cries; automatic repetition of one word or syllable; sudden weakness and trembling of voice; spitting.
>
> Finally, various miscellaneous reactions and vasomotor symptoms; general trembling; convulsions of lips and facial muscles, of limbs and of trunk; acts of violence to one's self, as biting fist or nails; sardonic laughter; bright redness of face; sudden pallor of face; extreme dilatation of nostrils; standing up of hair on head.

The complexity of these observable and recordable patterns is indicated by James in the following words: [5]

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[5] Wm. James, *Principles of Psychology* (Henry Holt & Company, 1890), Vol. II, pp. 447, 448.

Were we to go through the whole list of emotions which have been named by men, and study their organic manifestations, we should but ring the changes on the elements which these typical cases involve. Rigidity of this muscle, relaxation of that, constriction of arteries here, dilatation there, breathing of this sort or that, pulse slowing or quickening; this gland secreting, that one dry, etc., etc.

We should, moreover, find that our descriptions had no absolute truth; that they only applied to the average man; that every one of us, almost, has some personal idiosyncrasy of expression, laughing or sobbing differently from his neighbor, or reddening or growing pale where others do not. We should find a like variation in the objects which excite emotions in different persons. Jokes at which one explodes with laughter nauseate another, and seem blasphemous to a third; and occasions which overwhelm me with fear or bashfulness are just what give you the full sense of ease and power.

The internal shadings of emotional feeling, moreover, merge endlessly into each other. Language has discriminated some of them, as hatred, antipathy, animosity, dislike, aversion, malice, spite, vengefulness, abhorrence, etc., etc.; but in the dictionaries of synonyms we find these feelings distinguished more by their severally appropriate objective stimuli than by their conscious or subjective tone.

James's last suggestion here is very pertinent. The names we apply to emotions are regulated neither by the objective behavior components nor by the subjective patterns of quality. Emotions are identified chiefly by the situation in which they arise and by the subsequent results to which they lead. We find this beginning in childhood, as we have seen in the chapter on social perception. The earliest recognitions are of the *circumstances* in which a photographed person might have a particular facial expression. Only later do standardized names develop which profess to name the emotion itself. Whether it is possible to indicate a limited number of fairly recognizable emotional patterns which may be considered primary, and from which others are derived by combination and reduction, is still problematic. We shall consider this more fully at a later point in this chapter.

THE SUBJECTIVE PATTERN OF EMOTION

If we turn to the events subjectively reported by the emotionally active individual, we find them also to be extremely

complex and variable. First of all there is commonly reported a situation in which the emotion arises and to which it is attributed. This is most often an object or person whose acts, words, or status have some definite relation to the destiny of the reporter, usually that of constituting an obstacle to current activities or purposes. One is thus vexed *with*, angered *by*, afraid *of*, depressed *at*, definite perceived situations. Emotions, that is to say, are first of all responses or consequents, but the situation constituting the stimulus, or some symbol of that situation, is an essential part of the emotion. Emotions are responses not so much to simple stimuli as to relations, situations, or to simple events in their rôle as signs of more elaborate contexts or meanings. Both antecedents and consequents are thus complex.

Fears, rages, jealousies, depressions, in adult life, arise in social situations and settings. I am jealous of another, not because of what he is or has, but because of the relation of his status to my own and the limitations of my own activity or thought which result therefrom. I love my country not merely because of its "rocks and rills," but because of complex relations which it sustains in my whole history and present activity. Emotion contains first of all, then, a definite perceptual element, a cognition or knowing of the meaning of a sign or situation.

There is, next, introspectively, a host of qualities, spatially referred to the body. These are not the "higher" qualities of sight and sound nor the intermediate qualities of smell and contact. They are instead from the "lower sense" fields—stresses and strains of kinæsthesis, burning and chill, dryness, throbbing and pulsation in skin and other tissues, thrills and spasms of muscular contraction, twitching and irregularity of movement. Masses of qualities arise which we learn to localize in the viscera, the reproductive system, the internal bodily organs, the deep-lying tissues. There are widely distributed and loosely organized patterns which we identify as dizziness, crying, shrinking, choking, swelling, nausea, shaking, palpitating, twitching, shivering. Various aches, pains, and tensions occur, either locally or diffusely distributed; either

simultaneously or in shifting patterns of clearness, intensity, and composition.

The ordinary course of action and thought also observably changes. There are impulses to unwonted acts—to scream, strike, bite, push, caress, embrace. Speech is facilitated or impeded, and there are modifications in the quality, pitch, and loudness of the voice. The flow of thought is riotous or is blocked and paralyzed. Purposes disintegrate or assume unfamiliar tenacity. There are conspicuous, also, the qualities often reported as elementary and unanalyzable—pleasantness and unpleasantness, or relaxation, strain, excitement, and calm, in varying patterns.

The outcome of an emotional pattern varies. It may persist until it "wears itself out." It may serve so to reënforce current activities that these materially change the situation, either organically or externally or both. Or it may be supplanted by instinctive or purposive activity, so directed toward the provoking stimulus that new conditions are produced which serve to reëstablish bodily equilibrium and regularize the course of subjective events. In one way or another, the emotion is typically an urge, an annoyance, an obstruction to coördinated and systematic behavior. Emotions seem, on the whole, to represent disturbances. Either they are the breakdown of native and acquired adjustments, or they are the signs of disruptions that require adjustment.

Nor is the subjective pattern of emotional events exhausted in this enumeration. We have already indicated (*a*) the perceptual or cognitive features, (*b*) the mass of organic qualities, (*c*) disturbances of the ordinary course of thought and action, and (*d*) possibly unique affective qualities. We must add (*e*) purposes, that is, symbolic representations of techniques of alleviation.

THE IMPULSIVENESS OF EMOTIONS

For it is typical of emotion that it involves impulsiveness toward further action. We are not only *stirred*, we *want* also to do something about it; tentative movements of adjustment are present in the emotional disturbance itself. These are

adjustments, not only toward the exciting stimulus or situation, but also toward the emotional state or condition. Both call for modification.

The emotion, that is to say, is an elaborate craving, a pattern that calls for removal, and is, therefore, a striving, an urge. Even the inner bodily changes manifest this drive toward dynamic performance, in the way of emergency preparation and mobilization of resource. Some emotional conditions, such as rage, hate, fear, love, seem to lead natively to overt acts of attack, flight, or embrace. The emotion is present, indeed, only in so far as such "instinctive" acts are delayed and obstructed. Such emotions have been described as "preparatory reactions," which continue so long as the final or "consummatory reaction" is impeded or delayed.

It is in this sense that emotions are often described, along with instincts, as constituting the fundamental drives of action. Such an account fits readily into our conception of the nature of a motive. For an emotion is a persisting stimulus, leading vaguely to a general field of definite activities, which will allay the motive arousing them. Hate arouses a repertoire of vindictive acts, and is appeased when a specific deed humiliates the object, changes its status, and thereby removes the initial stimulus to the emotion. Fear leads to some adjustment which eliminates the presence of a stimulating situation perceived as dangerous. But "Hope deferred maketh the heart sick."

In civilized life the immediate technique of alleviating emotional stress is usually prohibited. Emotions, or significant and effective parts of them, persist perhaps for years, until "the law takes its course." Here then the technique of alleviation comes to be supplemented by a symbol; one fancies or imagines or plans some act which will "bring satisfaction." Emotions are thus transformed into *desires*, as simple cravings are transformed into purposes and intentions.

The emotion as motive is in this case combined with the symbol of a plan and becomes a persisting drive, purpose, or *desire*. In animals and primitive men, emotions are immediately impulsive. They are attached to instinctive acts or

simple habits. In civilized men, emotions are also impulsive, but more remotely, in connection with learned technique of vengeance, safety, aggression, triumph, or gratitude. Emotions thus suppressed and connected with symbols of techniques of satisfaction or removal become desires. Such suppression and organization of desires are a fundamental condition and prerequisite of the elaborate mental and social life of man.

When emotions are prolonged many of the momentary and violent constituents are reduced or eliminated, but the general core or disposition remains to constitute a *mood*. Protracted desires combine into elaborate dispositions, are organized and symbolized into ambitions, *sentiments*, and lifelong intentions or *values*. It is in this way that there originates the long array of characteristically human *wants*, which are added to the localized cravings and the bodily and intellectual feelings to constitute the dynamic agencies in mental activity.

CLASSIFICATION OF EMOTION

In spite of the infinite array of emotional patterns, varying with the endless list of initiating circumstances and the deviating idiosyncrasies of individuals, we should not overlook the possibility of there being a limited number of primary emotions. There is also an infinite number of substances in nature, but chemists recognize relatively few elements; there are thousands of words in our language, but only a few letters in the alphabet. If there were a limited number of elementary emotions, the infinite diversity of emotion names provided by the dictionary might be classified under these as degrees, nuances, combinations. No generally acceptable scheme of classification has been achieved, though many have been offered.[6]

James declared that such classification up to his time was "to a great extent either fictitious or unimportant and . . . its pretenses to accuracy are a sham. . . . I should as lief read

[6] See Appendix I.

verbal descriptions of the shapes of the rocks on a New Hampshire farm as toil through them again." But he then proceeded to describe "the *coarser* emotions, *grief, fear, rage* and *love,* in which every one recognizes a strong organic reverberation, and afterwards speak of the *subtler* emotions, or of those whose organic reverberation is less obvious and strong."

Allport has given one of the most careful accounts of emotion, from which the following paragraphs may be quoted in this connection:

> There are many complex emotional states which are familiar in daily life. Varying degrees of the affective qualities combine with the major emotions of fear, anger and love, and also with somatic attitudes for all possible reactions toward self and others. The main attitudes in which *fear* seems to be important are awe, reverence, bashfulness, surprise, wonder, suspicion, loathing and anxiety. *Anger* is recognizable in resentment, remorse, jealousy, envy, reproach, scorn and hatred. *Love* plays a part in gratitude, grief, pity, sorrow, fascination and perhaps humility. A number of bodily attitudes, other than attacking, fleeing and caressing, combine with pleasantness and unpleasantness to produce special emotional reactions. These states are represented by numerous varieties of approach and avoidance, as well as by joy, elation, pride, shame, domination, submission, and feelings of inferiority.
>
> The range of human feelings is indeed extensive. There are probably hundreds of *nuances* of emotional attitude which contribute to the richness as well as the delicacy of social intercourse. Modern fiction is primarily a play upon these attitudes. They are of interest for social psychology because they indicate the complexity of inter-individual adjustments in society. Almost every emotional *nuance* represents an attitude not only to feel but to react in a highly specific fashion toward some other human being.[7]

Many modern writers,[8] McDougall, for instance, are more generous in their list, but the tendency is in the direction of limitation. Thus Allport groups emotions first under the heads of pleasantness and unpleasantness. The former owe their tone to the visceral qualities arising from activity of the

[7] F. H. Allport, *Social Psychology* (Houghton Mifflin Company, 1924), p. 95.

[8] See Appendix I for suggestions of various proposed classifications of human emotions.

craniosacral segments of the autonomic nervous system, concerned chiefly with the functions of digestion and sex, and to somatic "afferent impulses from reactions carried out by unimpeded cerebro-spinal impulses." The unpleasant group "results from bodily changes which serve the ends of withdrawing and defense, and which are brought about by the sympathetic division" of the autonomic system. Within these two groups the differentiating features of recognizably different emotions are said to arise from the qualities afforded by or associated with the somatic part of the organism—the muscles, tendons, and joints.

FUNDAMENTAL EMOTIONAL PATTERNS

From observations of the behavior of newborn infants, Watson [9] concludes that there are but three typical "emotional reactions . . . belonging to the original and fundamental nature of man." Objectively described, these, and the stimuli observed to produce them, are as follows.

To sudden removal of support (as when dropped, or pushed, or shaken when sleepy) and to loud sounds, the responses are sudden catching of breath, clutching randomly with hands, sudden closing of eyelids, puckering of lips, and crying. The name "fear" is suggested for this pattern.

To hampering of movements, as by holding head or face, the response includes crying, stiffening of the body, striking movements, drawing up and down of legs and arms, holding of breath. "In older children the slashing movements of the arms and legs are better coördinated and appear as kicking,

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[9] J. B. Watson, *Psychology* (Lippincott, Philadelphia), pp. 199-201. Studies of this kind were made by Charles Darwin, who in 1840 recorded observations of infants, noting the early appearance of fear, anger, pleasure, and affection, and the evidence of conditioning (called association) as early as the fifth month. The observations of Darwin were suggested in his "The Expression of the Emotions in Men and Animals," and given in detail in *Mind,* Vol. II (July, 1877), p. 7. Later work consists chiefly in rendering more precise, extensive, and experimental this type of observation, and in modifying the interpretation.

slapping, pushing, etc. These reactions continue until the irritating situation is relieved, and sometimes do not cease then." This reaction is called "rage."

To the stroking of a sensitive region, tickling, shaking, gentle rocking, patting, turning upon the stomach, the response includes smiling, ceasing to cry, gurgling, cooing, and arm extension. The term "love" is suggested for this pattern of behavior.

Although this author admits the possibility of the list requiring extension on the basis of further observation, he is inclined to believe that the long array of names for human emotions applies strictly to attitudes, which are consolidations of emotion, instinctive acts, and habits, and to the breaking up and recombination of the components of the three primary reaction patterns. These undergo intricate processes of "conditioning" to new stimuli, ever acquiring new features in the way of instinct and habit components.

This is the process of emotional transfer, on which great emphasis is rightly laid, no matter how many or few be the fundamental emotional patterns. Thus Watson points out that "an individual hampers the use of the child's arms and legs, constrains it, holds it badly when dressing it (original conditions for arousing rage)—soon the mere sight of that individual arouses the rage components. Finally an entire stranger whose appearance is even slightly similar to that of the first individual may set off the responses."

It seems necessary to include at least one fundamental emotional pattern in addition to those here reported. In order not to identify these crude initial patterns with the more precisely differentiated emotions of later life, we may use somewhat more general names than those employed by Watson. The three patterns just described would thus be indicated as *resistance*, *startle*, and *content*. To these it seems necessary to add *gloom*. Its earliest manifestation is perhaps the discontented crying aroused by imposed shifts of position and similar changes not adequate to arouse startle or resistance. Later it is seen in a general reduction of bodily tonus, in the postural droop and loss of vivacity accompanying illness, and

in the facial expression aroused by loss and deprivation. Many lower animals also exhibit these pictures.

Such primitive emotional patterns are observed to occur originally in something like an all-or-none fashion; the response occurs whole-heartedly or not at all. Thus in infancy the intensity of the stimulus, the magnitude or importance of the occasion, bear little or no relation to the vigor of emotional display, which either occurs with full force or not at all. Growing up, emotionally, consists in part of imposing a system of graded reactions upon this all-or-none picture.

This process of gradation is the familiar one of redintegrative sequence and its special laws. The various steps may be indicated as happening in something like the following fashion:

(*a*) Original reactions are produced by total stimulating situations, which have not been analyzed into their component details.

(*b*) A partial detail of such a situation tends thereafter to provoke a reaction similar to that made to the total situation, even when this detail occurs in new contexts.

(*c*) This detail-evoked response is usually weaker than the original response, as is characteristic of consequents of incomplete stimuli. It may also be briefer, less extensive, and in other ways incomplete, but represents a familiar emotional core or tone.

(*d*) Details that have belonged to several antecedent contexts will be followed by responses which vary according to the laws of reënforcement and inhibition, and according to such influences as recency, frequency, and instigative potency on other grounds.

(*e*) Constellating details, belonging to diverse antecedents, will through their mutual reënforcements and inhibitions produce varied intermediate degrees of emotional completeness, as well as new patterns of combination.

From these simple beginnings of gradation, constellation, and transfer, evolves the complex emotional life of later years. Emotional and attitudinal reactions become infinitely elaborated, organized, differentiated, attached to remotely analogous objects and to more abstract features, relations, and situations. Attitudes thus are built up into more complex emotions and sentiments, about persons, acts, customs, ideas, institutions, duties, human relations, and even about general philosophies of life.

Emotions, being modes of behavior, are amenable to education in ways similar to those effective with other activities. Early emotional attitudes, becoming habitualized, and perhaps capable of evocation by situations only remotely analogous to those originally provoking them, may result in temperamental twists in later life, in sentimental, affective, and impulsive attractions or revulsions, dreads or discomforts and strivings. Because of the obscurity of their origin such personal idiosyncrasies are often grouped with more strictly native tendencies, as constitutional traits. We have already shown, in preceding chapters, how these personal attitudes illustrate the typical patterns of the mental paradigm.

Perhaps the most significant feature of emotion is its ease of redintegrative instigation. This is often described by such terms as "continuity of emotion," "emotional transfer," "affective spread," "siphoning of emotion or affect." These are, of course, but figures of speech. The fact to which they dramatically refer is that emotions are easily reinstated by situations only remotely resembling their original occasions. The fact itself is more instructive than the analogies.

THE FEELING TONE OF EMOTIONS

It may seem that undue emphasis has here been given to the annoying aspect of feelings and emotions. We have constantly noted that motives call for satisfaction, removal, alleviation. Are there not also feelings and emotions which are thoroughly enjoyed, and which we seek to arouse and prolong? Is all human life but a struggle for relief? Is there no positive delight in which we bask?

A strong case could be made out in favor of the position that human life, and animal life in general, *is* essentially a search for deliverance, and that pleasure consists in just that complacency and equilibrium which result from the elimination of urge and craving. It is at least true that most of our joys are those of *relief*. Triumph is clearly the removal of doubt and fear; joy indicates the solution or removal of some felt problem; gratitude is the experience of the rescued.

Even laughter, it has been urged, represents escape from a sense of inferiority.

In adult life, at least, pleasures consist largely of that complacency which comes with the banishing of misery, apprehension, dread, and uncertainty. Even the "joys of childhood" are closely linked with the removal of restraints, the restraints here often being such trivial items as doors, shoes, study, and household duties. In general, we may say that the process of satisfying (removing) any motive is "satisfying," that is, pleasurable. Still more generally, the unimpeded progress or facilitation of any dominant and current dynamic trend is agreeable, its frustration or interference is unpleasant.

Thus Stout points out that "every special kind of emotion essentially involves a characteristic end or direction of activity, mental or bodily . . . [and] an emotion is agreeable or disagreeable according as the conative tendencies involved in it are thwarted or gratified." Shand likewise observes that "every primary impulse, whether it is independent or belongs to a primary emotion, is intimately connected with the systems of fear, anger, joy and sorrow, in such a way that when opposed, it tends to arouse anger; when satisfied, joy; when frustrated, sorrow; and when it anticipates frustration, fear."

"Pleasantness," writes Woodworth, "goes with a neural adjustment directed towards letting things stay as they are; while unpleasantness goes with an adjustment toward riddance." "These . . . are the most important facts yet brought out as relating feeling to conduct." It is clear, therefore, why in a dynamic psychology in which mental life is activity, sequence, process, the annoyances play so large a rôle. For it is when such motives are present that "things happen." Pleasure represents, in the main, either progress toward or attainment of complacency, equilibrium, inactivity.

It must be noted that many things are pleasant or unpleasant besides emotions. Sights and sounds, tastes and smells, images, memories, forms, patterns, and structures in many fields may be characterized by agreeableness, disagreeableness, or indifference. The study of these facts is the problem of psychological æsthetics. What the varied correlates of pleasant-

ness and unpleasantness may be is still in many respects problematic.

There are reasons for believing that there are primary or native conditions of likes and dislikes. Our later array of fondness and aversions may have a long redintegrative history behind them. Some of the characteristic tendencies in such a history we have exhibited in earlier chapters on the redintegration of subjective events. Thus bitter and sweet, as mere taste qualities, or at least as stimuli applied to the tongue, seem at birth to arouse discriminative reactions either of spitting and rejection or of contented sucking. That in later life the very words "bitter" and "sweet" serve as synonyms for the disagreeable and the pleasant, at least suggests a long history of transfer and analogy. We must postpone our concern over the distressing character of most human emotions until the nature of distress has been more fully solved in the case of simpler situations.

CHAPTER XX

THE PSYCHOLOGY OF REASONING

The accounts of meaning, thought and idea, perception, memory, imagination, motivation, and purpose have already introduced the detailed features involved in reflection or cogitation. We need only to bring these contributions together in actual problem-solving activities and note how they conspire to constitute reasoning. For this purpose we choose from familiar fields of psychological literature three typical and oft-cited illustrations. They are (1) a case of problem solution by lower animals, (2) the human solution of unfamiliar mechanical puzzles, and (3) an instance of logical search for the answer to a perplexing question.

PROBLEM-SOLVING ACTIVITY IN CATS

The first case is from Thorndike's studies of animal intelligence. We are here concerned not with the increased effectiveness of serial trials, through learning, but in the momentary process of a single problem solution. Nor need we for the moment decide whether the cats here described actually reasoned or merely struggled. It will be most useful to begin with an account of the objectively observable features of such animal activity. Then we may attempt to formulate this behavior in general psychological terms which may, at least, show the relation of such activity to reasoning. The experimenter reports as follows:

I chose for my general method one which, simple as it is, possesses several other marked advantages besides those which accompany experiment of any sort. It was merely to put animals when hungry in inclosures from which they could escape by some simple act, such as pulling at a loop of cord, pressing a lever, or stepping

on a platform. . . . The animal was put in the inclosure, food was left outside in sight, and his actions observed.

When put into the box the cat would show evident signs of discomfort and of an impulse to escape from confinement. It tries to squeeze through any opening; it claws and bites at the bars or wire; it thrusts its paws out through any opening and claws at everything it reaches; it continues its efforts when it strikes anything loose and shaky; it may claw at things within the box. It does not pay very much attention to the food outside, but seems simply to strive instinctively to escape from confinement. The vigor with which it struggles is extraordinary.

[With two of the animals] the behavior was different. They did not struggle vigorously or continually. On some occasions they did not even struggle at all. It was therefore necessary to let them out of some box a few times, feeding them each time. After they thus associate climbing out of the box with getting food, they will try to get out whenever put in. They do not, even then, struggle so vigorously or get so excited as the rest.

In either case, whether the impulse to struggle be due to an instinctive reaction to confinement or to an association, it is likely to succeed in letting the cat out of the box. The cat that is clawing all over the box in her impulsive struggle will probably claw the string or loop or button so as to open the door. And . . . after many trials, the cat will, when put into the box, immediately claw the button or loop in a definite way.[1]

PSYCHOLOGICAL ANALYSIS OF THE CAT'S STRUGGLES

Stated in general terms, the processes here described start with an annoyance, a perplexity, a motive, produced by confinement. There is then, first, a perceptual situation and, second, an emotional consequent aroused thereby. This situation either natively (with most of the animals) or through learning (in the case of the two described) instigates a general field of consequents. A general type of activity, that of attack and escape, is prompted, rather than such general activities as play, basking, mating, or sleeping. There is a persisting bodily set or condition, which guides and predetermines the general course of conduct, up to the moment of success. This

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[1] E. L. Thorndike, *Animal Intelligence* (Macmillan Company, 1911), pp. 35, 36.

is the drive or motive. There are "evident signs of discomfort and of an impulse to escape."

The next general observation is that, from moment to moment, *particular* acts are provoked *within* this general field of native or learned escape activities. What each act precisely is, the varying local stimuli determine. These effective local stimuli change with each shift of the animal's position. The cat now squeezes, now thrusts, now claws, now bites, according as bars, openings, wires, or strings appear. All these are acts which natively or through learning have come to serve two ends. For one thing they progressively reveal or define the confining and discomfort-arousing situation. Now one, now another point is attacked, but since each attack is overt, we can scarcely call this serial struggle an analysis. Moreover, these are acts calculated, in the past history of the cat, to alleviate the craving or annoyance which constitutes their motive.

There is, therefore, a serial tryout of various alternatives, each instigated by local features of the situation of confinement. Two determinants thus conspire throughout the process, the persisting motive (discomfort) and the local stimuli (bars, wires, strings, etc.). These are the *specifying* and *instigating* cues described in earlier chapters as characterisic of mental activity. This constellation of determining tendency and local sequence continues until an act occurs which solves the problem, alleviates the motive, concludes the activity.

The cat's serial analysis of the situation was overt, and we cannot say that symbols of any sort were used by way of *representing* activities not actually indulged. Its activities, as observable, are overt scatchings, clawings, bitings, directed straight upon immediate present objects in turn. In the absence of symbols we cannot attribute ideas or thoughts to the cat. Nor can we assert that purposes were present. For purpose, as we have seen, involves the coalescence of a motive with some plan, some symbol for a technique of alleviation.

We cannot, therefore, credit the cat with reasoning. But that it solved its problem cannot be denied. The combination

of motive and local stimulus, in calling forth native or acquired repertoire so as to lead to a conclusion and to complacent equilibrium, is present. This constitutes a feature of all problem solving. We have here, then, at least the roots and the fruit of reasoning, if not its foliage and flower.

HUMAN SOLUTION OF PUZZLES

The solution of unfamiliar mechanical puzzles affords neat and simple problems for experimentation with the thinking of human beings, on a level not unlike that of the animal in the box. Ruger has reported series of such experiments, with descriptions, partly objective, partly subjective, of the process involved. The following samples will serve as material for our own discussion. The order of their arrangement here is significant, as the subsequent discussion will show.

1. "I have no idea in the world how I did it. I remember moving the loop of the heart around the end of the bar, and the two pieces suddenly came apart."
2. "I tried random fumbling for several minutes purposely to see if anything would turn up. . . . I was only inattentively aware of what I was doing, and did not plan it out. Was shocked with surprise when the rider came off."
3. "As I progressed I had a dim idea that I was doing something, and gave careful attention. As I did this I saw that I had not merely made a difference, but had entirely freed the end of the chain which I had used as a loop, and that therefore I could entirely free the chain from the stick. I saw this a little before I came to it, but not when I started the movement of the loop through the hole, nor even when I passed the rest of the thing through the loop."
4. "I began with rather aimless . . . moves . . . with a little analysis preceding each, but with no attempt at a complete analysis. Each time I would find myself brought to a stop without finishing and would have to analyze. Finally I analyzed the whole thing out beginning at the end, as follows: Since the hole marked 'Havana' is to be left open till the last (according to directions), the two holes distant two places from this can be left to the next to the last; the two holes distant two places from these come next in order. I followed back in this way till I saw which were the first that must be filled. My analysis worked promptly."
5. One of the subjects was given the task of solving a fairly diffi-

cult puzzle without touching it. Three hours were spent in consideration of the puzzle before the subject felt sure that he had solved it. . . . A quotation or two from the subject's notes may throw some light on the difficulties involved.

"I guess this last was wrong, for the folding ring would not drop from the staple to the split ring, as I had thought; and as it does in the case of the small staple, where it falls across without trouble upon the larger staple. But does it do this? It is hard for me to be sure. Simple as the question seems, I cannot easily, without trial, make out the answer.

"But if I imagine a solid ring in the position into which I have supposed the folding ring to 'fall,' I see that it could not be got back into the original position of the folding ring, and thence I conclude that I was mistaken in supposing that the folding ring would simply fall over on the large staple. . . . If I could see how to put the folding ring—supposed to be entirely off—on to the larger staple, I should have it. . . . I am anxious to put my plan to test. I believe that I can see through it all right."[3]

PSYCHOLOGICAL ANALYSIS OF PUZZLE SOLVING

In these five fragmentary but typical pictures of human problem solution we begin with activities precisely like those of the imprisoned cat. The "puzzle" is by definition a "perplexity." The urge or motive is, to be sure, more abstruse and abstract. It consists of that baffled state into which one is thrown by the inability immediately to meet the challenge, "Solve this puzzle." The stimulus to the motive is, therefore, largely symbolic—the words of the experimenter, the social situation, the directions, as to the thing to be done. The more immediate stimuli are the *relations* of the parts of the mechanical puzzle, not their number, shape, size, or color.

The subject of such an experiment can readily deliver an oral report of a relatively complex emotional state, in which localized, bodily, and intellectual feelings conspire to constitute an "urge to solution" or an "impulse to escape." Only solution will alleviate the humiliation and discomfort of the

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[3] The foregoing quotations are from H. A. Ruger, "The Psychology of Efficiency," *Archives of Psychology*, 1910, pp. 21-25.

situation. The puzzle itself is a challenge to attack and mastery, and the individual can well enough set the problem for himself. He will find the emotional state either increased with failing efforts, or reduced and transformed into general pleasantness if the march to solution is facilitated. The reader can best appreciate the reality and character of this complex "problem feeling" by trying to solve some fairly difficult and unfamiliar puzzle, meanwhile observing the flow of subjective experience. He will find it much too complex for ready description and will be inclined to give large names to the general meanings of such feelings and patterns as occur.

In the first two cases quoted, this vague but urgent motive specifies only overt manipulation of the apparatus, "random fumbling." Now this, now that part catches the eye and invites push, pull, or twist. And the solution when it comes is as accidental as in the case of the cat in the box. Yet motive and local cues, operating through a repertoire of native and acquired modes of manipulation, are present throughout.

In the third and fourth cases, the subjects reveal the use of ideas or symbols. The introspection is naïve, and *what* the ideas were is not disclosed. We are given only verbal synonyms for them, as if the thinking were but a verbal series, which was in all probability not the case. The signified, not the signs are reported; processes are not described, but meanings are instead indicated, synonyms spoken. But in some way or ways, verbally, through imagery, in terms of kinæsthesis of gesture, nod, eye movement, fixation, or otherwise, techniques of solution began to be *represented* or *symbolized,* in advance of their execution.

A plan appears, not at once, but gradually, and supplementary to "aimless moves." That is to say, "analysis" now begins to appear—mental rather than overt analysis. Not only are different parts of the mechanism overtly attacked, in serial order, as in the case of the cat. There is also *tentative* manipulation, *fancied* twist, *represented* movement, *imaged* sequence, *verbal* rehearsal, of act and order and relation.

Along with direct manipulation there is indirect or sym-

bolized operation. This *runs ahead* of performance. There is, therefore, the appearance of plan, in which relations are *indicated* and acts *intended*. These are techniques of solution. Their presence, along with the motive and the local cues, transforms the "fumbling" into "purposive action." The symbolic character of the items thus manipulated in thought makes of them *ideas*. These individuals were, therefore, beginning to *reason*, in the midst of their struggling. We are indebted to them for a neat exhibition of the differentiating marks of this process.

In the fifth instance, overt manipulation was prohibited. All operations were thereby made to be symbolic. Fancied relations and changes must now be *represented* by such symbols as eye movements, bodily set, asymmetry of muscular tension, verbal indication, imagery, feeling, gesture, or whatever repertoire of *ideational material* is available to the subject.

Motive and local cue conspire with symbolized plan, and the whole process is one of purposive thinking, that is, reasoning. The motive or problem guides the process throughout. It prescribes the action of local cues, arouses and evaluates the ideas or plans of solution. The whole course of solution by *mental analysis* (symbolic manipulation) is thus a meaningful rehearsal, an act of thought. The process terminates with the symbolic or imaginary alleviation of the motive. "I believe I can see through it." Complete certitude fails only because a final and practically important step in reasoning is that of *verification*, which is here prohibited by the experimenter.

Here, also, we are unfortunately not admitted to the intimacies of the subject's thought. We do not know *in what terms* he symbolized the fancied acts and relations. We are given, as before, only verbal intimations, synonyms, indications of meaning, not accounts of process. We are told that he "had a thought," seemed "wrong," "was not sure," "imagined a solid ring," could "see that it would not go back," "supposed the ring would fall," "could see how," had a "plan," and "could see through it."

Some of these are clearly figures of speech (as in the case of "seeing through"). None of them are descriptions of his thoughts; they are, at best, but other signs, synonyms for them, verbal equivalents. We are afforded, therefore, only a *logical* story, a bare relational scheme which enables us to map out the course of thoughts, without knowing what they are, knowing only "to what they refer." The map is sufficiently definite to permit us to say that the subject was *thinking*, was symbolically and purposively *rehearsing*, was *reasoning*. But we are quite unable to give any psychological account of *how* this reasoning proceeded, what signs were used, or for precisely what past contexts they functioned in the instigation of consequents.

THE LOGICAL PICTURE OF AN ACT OF THOUGHT

A logical map of the course of reasoning serves good uses, since in practical life it is the outcome, not the materials of thinking that is considered vital. A functional, as distinguished from a descriptive, psychology will emphasize the logical map and the hygiene and pedagogy of its course, ignoring the descriptive problem. The logical scheme may be common to many individuals, whereas the psychological materials will vary enormously with individual idiosyncrasy. We may, therefore, profitably give some further attention to the general logical course of reasoning, before presenting an illustration of more adequate psychological analysis.

We use for this an illustration taken from Dewey's famous "analysis of a complete act of thought." A problem, puzzle, or perplexity arises, taking the form of a question. This question is fairly answered on the basis of a typical "reasoning process." Here, also, the account is at least a stage removed from immediate psychological observation; it is a verbal, logical, or common-sense narration, of the "import" of what actually happened. No revelation is made of the actual processes of thought. Instead, verbal synonyms point to the "meanings" for which these thoughts stood, much as if the whole process had been an elaborate verbal series. What the

actual events and mental processes were, we can, therefore, only surmise. But we may follow the author's account, for the sake of noting the various logical steps which are discernible therein.

Projecting nearly horizontally from the upper deck of the ferryboat on which I daily cross the river is a long white pole, bearing a gilded ball at its tip. It suggested a flagpole when I first saw it; its color, shape and gilded ball agreed with this idea, and these reasons seemed to justify me in this belief. But soon difficulties presented themselves. The pole was nearly horizontal, an unusual position for a flagpole; in the next place there was no pulley, ring, or cord by which to attach a flag; finally there were elsewhere two vertical staffs from which flags were occasionally flown. It seemed probable that the pole was not there for flag-flying.

I then tried to imagine all possible purposes of such a pole, and to consider for which of these it was best suited: (*a*) Possibly it was an ornament. But as all the ferryboats and even the tugboats carried like poles, this hypothesis was rejected. (*b*) Possibly it was the terminal of a wireless telegraph. But the same considerations made this improbable. Besides, the more natural place for such a terminal would be the highest part of the boat, on top of the pilot house. (*c*) Its purpose might be to point out the direction in which the boat is moving.

In support of this conclusion, I discovered that the pole was lower than the pilot house, so that the steersman could easily see it. Moreover, the tip was enough higher than the base so that, from the pilot's position, it must appear to project far out in front of the boat. Moreover, the pilot being near the front of the boat, he would need some such guide as to its direction. Tugboats would also need poles for such a purpose. This hypothesis was so much more probable than the others that I accepted it. I formed the conclusion that the pole was set up for the purpose of showing the pilot the direction in which the boat pointed, to enable him to steer correctly.[3]

ANALYSIS OF THE COURSE OF REFLECTION

The first step in such an act of reasoning as that just described is shown to be "a feeling of discrepancy or difficulty," either vaguely present or definitely localized, identified and

[3] J. Dewey, *How We Think* (D. C. Heath and Company, New York, 1910), p. 69.

named in relation to the situation or stimulus which provokes it. "In cases of striking novelty or unusual perplexity, the difficulty . . . is likely to present itself at first as shock, as emotional disturbance, as a more or less vague feeling of the unexpected, of something queer, strange, funny, or disconcerting." There are "observations deliberately calculated to bring to light just what is the trouble, or to make clear the specific character of the problem."[4] In careful thinking a preliminary period of suspense may mark this "diagnosis," or "inquiry to determine the nature of the problem."

In the next stage, the motive, problem, or annoyance, thus localized and attributed to an identified stimulus, arouses, natively or through learning, symbols of techniques of alleviation. The logical writer calls this "suggestion," and says: "The situation in which the perplexity occurs calls up something not present to the senses. . . . It involves a going from what is present to something absent."[5] But it is clear that what is intended is the statement that a *present symbol* is aroused, which *functions for* "something absent." The distinction must be clearly held in mind, by the psychologist, altogether it is unimportant for the logician, perhaps.

"The stick before the eyes [arouses] the idea of a flagpole, an ornament, an apparatus for wireless telegraphy." These tentative conclusions, symbolized but not adopted nor executed, are plans, conjectures, hypotheses. They are present symbols for past acts, objects, situations. They are thus "ideas," or "thoughts," owing their significance and effectiveness to past contexts of which they have been features.

Effective reasoning will depend in part on the variety and appropriateness or relevance of such represented contexts. In the logical words of Dewey, "Postponement of a final conclusion pending further evidence depends partly upon the presence of rival conjectures . . . [hence] cultivation of a variety of alternatives is an important factor in good thinking." Psychologically, this restraint and sagacity depend on

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[4] *Ibid.*, p. 73.
[5] *Ibid.*, p. 75.

the native repertoire and the richness of past learning. For the conjectures must be instigated by the observed situation, plus the motive it arouses, in the light of the past contexts in which its details have played a part. Conjectures are not spontaneously generated nor given by inspiration. They are responses to stimuli, consequents of antecedents, dependent on heredity or on experience.

The next step is the symbolic development of the various "conjectures" or "plans." In fancy, through imagery, speech, gesture, diagram, or other available signs, each plan evolves serially from step to step of its "imagined execution." This is the development of "implications." As the technique of alleviation is thus "rehearsed in mind," its relations to other plans and to the original situation and motive are discovered. Each "mental rehearsal" terminates either in a reduction of, or in an increment to, the original feeling of difficulty. This change is called assent or dissent, acceptance or rejection.

Thus Dewey writes:

> The implication of a flagpole is seen to be a vertical position; of a wireless apparatus, location on a high part of the ship, and moreover, absence from every casual tugboat; while the idea of index to direction in which the boat moves, when developed, is found to cover all the details of the case. . . . Conjectures that seem plausible at first sight are often found unfit or even absurd when their full consequences are traced out. . . . Suggestions at first remote and wild are frequently so transformed by being elaborated into what follows from them as to become apt and fruitful.

This stage of "developing the implications" is, therefore, psychologically, full of organic feels and intellectual relations as well as of varied observations of relations, structures, and compatibilities among the objects of the "higher senses." One "sees" the *slope* of the stick, its *relation* to the pilot house, the *incongruity* of flagpole without pulley. One "feels" successive expectations, conflicts, surprises, assents, reliefs, and certainties. It is the effect of those feelings upon the original perplexity, emotion, or motive that constitutes "solution." This is true no matter how *valid* the adopted solution may be

when overtly tried out or realized in the world of fact and action.

Strictly speaking, this stage concludes the reasoning process. All that remains is the task of *verification* or of refutation. This is often an overt experiment, consisting of some relatively direct application. There is then noted the degree and permanence of the reduction of the original motive or problem. If the solution is valid, the problem is dismissed and should not recur. If the solution is "wrong," the momentary complacency is illusory and the annoyance will reassert itself.

REVIEW AND SYNTHESIS

It should now be apparent that the three situations, animal struggle to escape, human puzzle solving, and logical reflection in search for the answer to a question, form a continuous series. Features of rationality are present in them all; but the series begins with a few such elements, gradually exhibiting more and more of them until the "complete act of thought" is portrayed.

In the case of the cat's struggle, motive and local cue combine to instigate acts, on the basis of the animal's native equipment and past learning. Meaning is present, in so far as present stimuli evoke responses determined by past situations in the cat's biography. But symbols or ideas are lacking; hence plan, purpose, and mental rehearsal do not appear.

In the human puzzle solving, all the features appear that characterize the cat's struggle. But gradually, thanks to the use of symbols and the richer fund of learning, ideas come to be substituted for acts, and mental rehearsals take the place of motor fumbling. The plan is thus made possible, and, combined with the motive, it gives the aspect of purposiveness.

Finally, in the case of logical reflection, overt fumbling falls away completely. Even the initial stimulating situation, the problem-arousing stimulus, need not continue in its primary sensory form; it may be represented through the course of reflection by symbols for it. Thus the "ferryboat" situation might continue to constitute a "task" long after the boat had

gone, in the form of verbal or imaginal surrogates. The motive and the local cues are present here also. But in the place of random fumbling there appear alternative hypotheses. These are symbols of solution techniques—plans and programs. Coalescing with the determining motive and the local stimuli, these plans are tentatively, that is, symbolically, elaborated, mentally rehearsed. Purposiveness is conspicuous. The items manipulated are symbols, ideas. The search is for a conjecture that will alleviate the motive. And again, the probability, speed, and validity of the conclusion depend most of all on the richness of past learning which the reasoner possesses. For the suggestion of conjectures and the development of implications are only the symbolic rehearsal of larger contexts and absent situations. Before these can be represented in thought they must have been lived through in fact or vicariously experienced through previous use.

The distinguishing features of an act of reasoning we may, therefore, briefly recapitulate and enumerate. They are:

1. A perceptual situation, factually or symbolically present, evoking a persisting motive or perplexity, which tentatively arouses a general field of acts calculated to relieve it.
2. Local stimuli, conspiring with the determining motive to instigate suggestions, on the basis of native equipment and the fund of learning.
3. Symbolization, which enables the tentative, ideational entertaining of these techniques of alleviation, in advance of their execution. Partial details function for previous complexities.
4. Mental rehearsal or elaboration of these techniques, arousing organic and intellectual feelings, which add to or diminish the initial motive or perplexity.
5. Adoption of the symbolized technique whose elaboration dispels the problem attitude and eliminates or alleviates the motive, restoring complacency and equilibrium.
6. Experimental verification or test, on the outcome of which will depend the permanence and degree of alleviation.

Nothing new is involved in reasoning, no processes or acts not already exhibited in previous chapters. Reasoning is not the operation of a special instrument or agency. It is a definitely patterned course of natural events, objective, subjective,

or both. Its laws are those of the redintegrative paradigm. Its success depends upon richness of past experience, delicacy of response to subtle cues, and the potency of details to function for their past contexts.

DESCRIPTIVE ACCOUNTS OF REASONING

We require now more precise reports of the actual events occurring during a reasoning process. The objective movements may be recounted by the experimenter, as in the case of the observer of the cat's struggle. But many of the events are less accessible, and are best described by the subject of the experiment, who alone has direct access to many of the symbols and processes involved. We may limit the description to the elaboration of alternatives and the choice of a satisfactory one. In laboratory experiments the alternatives may be provided and controlled, thus rendered alike for all subjects. But their elaboration and choice are individual matters.

In the first example, the subject is presented with two sounds, one second apart, and required to compare them, characterizing one as louder, softer, or equal, as compared with the standard. The report is quoted from Fernberger's "An Introspective Analysis of the Process of Comparison." It is particularly interesting to note, in this typical account, the significant features, such as the development and final reduction of "strain," the symbolization of the original stimuli (sounds) in other terms (visual images), the attentive consideration of the respective alternatives, the richness of kinæsthesis, the use of relations of symbols (images) as representing relations of the original objects (sounds), and the resolution of the problem attitude with the adoption of one of the alternatives.

In the fore-period there was a strained condition of the muscles about the throat, brows and chest, which gradually increased to a marked degree of intensity. This was concomitant with a quite clear visual schematic image of the experimental situation in which the apparatus and the experimenter were clearly imaged.

Upon the first stimulation the auditory quality never stood out

very clearly, although it gradually increased in clearness and intensity. The auditory perception was accompanied by a rather marked motor reaction which included slight tendencies for the eyes to shut tightly for an instant, for the musculature in the throat to contract and an inhibition of breathing. Along with this was a continuation of the strains of the forehead and I immediately found myself focally attending to the auditory stimulus and hanging on to it. This turned to an auditory image which continued practically to the perception of the second stimulus. The principal feature was that I tended immediately to visualize the first stimulus. I saw it stretched out in a sort of visual schema like the tail of a comet, but instead of growing larger it grew smaller from the place where it started.

The auditory perception of the second stimulus rose to its maximum degree of clearness and intensity much more rapidly than had the first. Nevertheless it did not last so long. There was not so much tone in it; it was more of a noise, relatively, than the first stimulus, but these features I did not notice as being relative at the time. Attention did not go to them. All I was aware of was a sudden finding of myself focally attending to those qualities I have just given, with muscular relaxation in the throat, eyes and chest.

But this muscular relaxation was less focal in consciousness than a visual schema which again came in. This was again an image of the comet which I have described a moment ago, localized to the right, and very much shorter than the other had been. There was eye movement all along this schema which came in concomitantly with the general muscular relaxation.

When the eyes had reached the further end of my image there was vocal-motor auditory imagery of the word "softer." It seemed to me that the focal and important thing in the whole experience was this visual schematization.[6]

The second illustration is from Wheeler's "Experimental Investigation of the Process of Choosing." The subject was given the names of two universities, and was to decide at which he would prefer to accept a teaching position. The choice was to be made, if possible, without the use of kinæsthetic processes.

As I perceived the name "Nebraska," I had a series of very richly detailed visual images of the campus at the University, with large

[6] S. F. Fernberger, "An Introspective Analysis of the Process of Comparison," *Psychological Review Monograph*, No. 117 (1919), p. 31.

crowds of students walking from one building to another; the buildings were large and impressive. Then I had visual images of the campus at Indiana; the buildings were smaller and smaller groups of students were walking about the buildings. Then I had visual images of the Psychological Laboratory at the University of Indiana, and I saw, one by one, various men who have taught psychology there; these latter processes were accompanied by sensations from inhibited breathing and from tensions about the brows, arms and shoulders.

I then turned my regard suddenly to the left (as if to inhibit the kinesthetic processes by turning to the other alternative) and again had visual imagery of the University of Nebraska stretched out before me. Then I brought both universities into a visual-kinesthetic schema with Indiana at my right and Nebraska at my left; I visualized the laboratory at Nebraska; it was large; there was an instructor leaning against an experimenting table; then I saw the large buildings, campus, and crowds of students walking to and fro; I then saw myself in the laboratory; I was conscious of a feeling of ease, expressed in general bodily relaxation, in incipient tendencies to smile, and to take a deep breath.

These processes were suddenly broken into by an awareness of the Aufgabe [instructions] in terms of a visual image of the experimenter, whereupon these sensations from bodily relaxation and tendencies to smile gave way to a general bodily rigidity and tenseness, with tendencies to frown; I was again conscious of the visual-kinesthetic schema; I sat up more erect in my chair; then I seemed to be standing mid-way between the two universities as the schema extended out wider from right to left; I had incipient tendencies to incline my head toward the left and forward; I had kinesthetic imagery of walking in the direction of Nebraska to the left; but again I became aware of the experimenter; then there quickly followed manual-motor imagery with incipient movements of pushing aside the schema to my right, which meant to me a "rejection" of the Indiana alternative.

All this time I was trying to express my choice in other than kinesthetic terms; several times I was choosing the "Nebraska" alternative, but found that each choice was kinesthetic in character as well; then I resorted to nodding my head toward the "Nebraska" schema, but recognized that this was motor, also; then I said to myself in vocal-motor terms: "I cannot prevent kinesthetic processes from coming in; I have already chosen the Nebraska alternative two or three times and rejected the Indiana alternative once, but each acceptance or rejection has consisted of motor processes."

Then came more visual imagery of the Nebraska situation; a general feeling of bodily excitement, expressed in heightened circu-

lation, in strains about the face and neck, in organic sensations about the diaphragm, and in the vocal-motor: "Well, I am choosing the Nebraska alternative again." Then there came the vocal-motor: "All right, I will get it this time!"; kinesthetic imagery of taking a long, deep breath, incipient tendencies to pull my shoulders together and to sit more erect in my chair. (This constituted a resolve to do my best to fulfil the instructions and to try again harder than ever.)

The visual schema appeared again; Nebraska was on the left and Indiana on the right; I immediately found myself experiencing kinesthetic imagery and incipient movements of extending my arm in the direction of the Nebraska schema to the left; there were also incipient shoulder movements; once more my attention shifted abruptly to the experimenter and the Aufgabe; I had the vocal-motor: "I can't do it," together with very intensive strains about the face, in the throat, chest, arms and shoulders. The verbal processes meant to me that I was unable to fulfil the instructions.[7]

Careful study of the details of such reports is very instructive. Thus, in the present instance, we see the problem attitude arising in terms of strain sensations. The local stimuli, the two names of universities, at once set up, in coöperation with this motive, processes of elaboration and development. Other contents or events at once assume the rôle of the two names. Motor processes and visual schemata become symbols for the universities, displacing the names as objects. The development of the alternatives takes the symbolic form of the magnitude and number of images (buildings, students) and the spatial position and relations in a visual diagram (right and left). These spatial relations of the schema reflect the geographical locations of the two universities. Accepting a position is symbolized by some motor act of acceptance of one side of the schema (inclining head, pointing, walking, pushing aside).

These processes, here richly described, are capable of translation in verbal terms, as the subject has given them in his introspective report. We have, then, more than a logical map

[7] R. H. Wheeler, "An Experimental Investigation of the Process of Choosing," *University of Oregon Publications*, Vol. I, No. 2 (January, 1920).

of the course of reflection. We have at least a partial intimation of the actual events involved in the elaborate play of sequences constituting the reasoning process.

And it is to be noted in this instance, in contrast with the situation in the former example, that the initial strain attitude is not relieved. Instead it now becomes "very intensive," since it was found impossible for a choice to be made that did not involve kinæsthetic process. It should now be recalled how important kinæsthetic processes appeared to be in the analysis of intellectual relations, in an earlier chapter. It is especially important that the student should realize, from such a rich report of so limited a section of a reasoning process, that such activities are commonly much more elaborate and profuse than the verbal account of the logician might lead him to suppose. The psychology and the logic of thought are not identical.

SPECIAL OR FORMAL MODES OF REPORT

As we have already seen, in practical life interest attaches especially to the *conclusion* of a thought process, with little concern for the procedure whereby that verdict was attained. The individual confronts a problematic situation, and what is required of him is not an introspective account of his experiences, but a *report* of the situation. The expert investigates, reasons, and delivers his *testimony*. His retainers are little concerned with his procedure, but willing to pay well for his *opinion*. The jurymen are allowed to conduct their deliberations in private, but in public they are required to deliver a *verdict*. The teacher sets a task for the student, and invites, not an intimate revelation of the subjective events provoked, but an *answer*. Aside from the question of the special materials employed, there are certain more or less formal modes of arriving at *reports* of this kind, which we may here consider. They are indicated especially by such terms as *observation, judgment, inference*, and *belief*.

Since these modes are the same for a great variety of materials to be reported, we may take the case of reporting a *relation* between things. Such reports play a large part in

enterprises calling for discrimination and involving individual differences in sensitivity, as in measurements of acuity, threshold, and limen. A report may be evoked in various ways, based on various grounds. It may be a response to an original total situation, or it may be evoked by a partial detail or a secondary cue. Such a cue is a vicarious stimulus, a substitute, or symbol. It may, as cue, be an event of any sort—quality, pattern, relation, or process. Or such a detail as a word, associated with this vicarious stimulus, may in its turn act as a vicarious substitute for the original symbol and, through it, for the initial total situation or object. We may first consider the four conventional modes of report, in the case of relations of comparison, thereafter generalizing our findings. What we seek are especially the differentiating marks of these formal modes of report.

THE REPORT OF OBSERVATION

Relations may be discovered in more than one way. The simplest is that of directly encountering them and knowing and naming them for what they are. Thus I may hear two tones in succession, and directly note their sequence. The relation of sequence is as directly encountered as are the tones themselves. If I am looking for pitch relations instead, the temporal relations may go unreported. I may even get the relation while confronted by but one of the members of a pair, as when I note that some change has occurred without identifying the objects between which the relation of difference occurs.

In this direct way I may confront the similarity of two colors, the equality of two weights, the relative beauty of two objects, the desirability of two alternatives. The relation may be clear and distinct, its certainty great, and its report explicit. These are, indeed, usually the case when relations are directly confronted. Such direct report of a relation, in its own character, is an *observation* of it or depends on an observation. The fact that the event is relational rather than olfactory or kinæsthetic makes no difference in the act of

noting and naming or otherwise reporting it. Thus if I name the relation, I do so just as I name any other object or event. Naming is a response to the object, a consequent instigated by it, just as kicking it or picking it up might be.

THE REPORT OF JUDGMENT

There is a second mode of reporting relations, which has peculiarities of its own, and which has sometimes been called "mediate perception." Since, as we have seen, all perception is mediated, is response to partial cue, this designation is unfortunate, and the term *judgment* is more appropriate. I may, in comparing two movements, report one longer than the other, not because of direct observation of space relations, but instead because one movement requires a longer time for its execution. I may report to-day's sky clearer than yesterday's because, on observing the ground shadows, I find them more distinct. I may compare the pitch of tones, not by observing the tonal relation itself, but by noting the laryngeal movements involved in producing them. I may estimate one garment to be of better quality than another, not by direct comparison of texture, but by inspection of the price tags.

In such cases a primary relation is affirmed, usually with considerable certainty and accuracy. But it is not on the basis of the immediate observation of the relation reported. In each case the knowledge of this relation is mediated. By comparing C and D, I directly observe a relation of one sort, and this is a surrogate cue for my report of a very different relation, between A and B. The designation of such a mode of report as judgment accords with a common meaning given to this term in daily life. Thus the eyewitness directly observes the criminal's guilt, but the magistrate or jury can only judge it, on the basis of comparative study of the testimony. When direct observation fails, we rely on our judgment, that is, on our interpretation of secondary relations. Such processes have often been experimentally studied.

In judgment, then, of relations of comparison as here illustrated, a real comparison occurs, but the objects compared

are not the objects that are judged. The relation observed is not the relation reported. But the cue to report is a relation, a surrogate for the relation reported. Both item observed and item reported are in the same general class; both are relations.

THE REPORT OF INFERENCE

In comparison through *inference,* a relation is based on a mediating process also, but not on the observation of a relation. I may infer that one time interval is longer than another because I become restless before it ends. I conclude that one automobile is better than another of the same make because it is used as a demonstration car. I assume that one man is wealthier than another because he plays golf or chess. I infer that last winter was more severe than this because I remember that the street cars were stopped for several weeks. Here the reports of comparison are mediated or instigated by an event which is not itself a comparison, nor even a relation. A bit of extrinsic knowledge is taken as a sign or index of a certain relational status of the primary objects.

Here then are three modes of report—observation, judgment, and inference. They are distinguished, not by presence or absence of characteristic subjective content, but by the formal technique of their instigation, by the data on which they are based. They are, to be sure, not sharply separated in occurrence. Thus the so-called perception of distance involves all three modes of report. There is direct observation of linear magnitudes; judgment on the basis of eye movement and strain of accommodation; and inference on the basis of intervening objects, rate of motion, haziness, and color.

The knowledge or report of time affords a neat instance of all three modes of reporting relations. Very short intervals may perhaps be directly compared and estimated. Somewhat longer intervals are judged, on the basis of secondary relations, such as the comparisons of strains, of feelings, of impatience, and the like. Still longer intervals are inferred, on the basis of position of the hands of a clock.

THE REPORT OF BELIEF

In addition to these familiar modes of report, there is a fourth, which may also be illustrated in the case of relations of comparison. This is the process in which we report relations on the basis of the testimony of another reporter. My instructor informs me that with a given luminosity, printed matter is more legible in red light than in blue. He affirms that he that ruleth his spirit is greater than he that taketh a city. Or I read that auditory reaction time is shorter than reaction to visual stimuli. I have faith in the honesty of my informants; that is, I accept the relations as reported by them, and in turn report them on the basis of this testimony. Such a report, based on the verdict of another reporter, may be designated *belief*.

We may now generalize these distinctions so as to make them applicable to items other than relations of comparison. In observation, the item reported is itself the datum, the cue of report. In judgment, the datum or cue of report is not the item reported but a surrogate item belonging, however, in the same general class with the item reported. In inference, the cue of report is both a different item and one in a different general class than that of the item reported. In belief, the datum is the report of another witness, and the grounding of the report of the informer is not indicated; it may be based on observation, judgment, inference, or belief. The terms apply not only to the report of relations, but to verdicts concerning any subject matter.

Empirical investigation in these fields is chiefly concerned with the study of the circumstances, the confidence, and the accuracy of such reports. A very imposing part of the literature of experimental psychology is concerned with the topic of report, under various captions. Typical headings are those of perception, discrimination, thresholds, testimony, comparison, memory, sensory acuity, recognition, intelligence, fatigue, reaction time, psychophysical methods, and the like. Starting with the definitions we have given, a long array of problems arise, meriting empirical investigation.

IMPLICATION AND THE SYLLOGISM

Implication, of which much is made in the logic of thought, is only psychological meaning. Parts imply the wholes of which they are fragments; details function for antecedent contexts. One thing implies another only in so far as it has been learned to do so, directly or vicariously. "Three equal angles in a triangle imply three equal sides." This is no epistemological mystery. The simple fact is that "equal angles" is part of past contexts or totals including "equal sides." The part may now be used as a sign of the whole, and thus of other parts. The substitution of parts for wholes, (redintegration) in the instigation of consequents, responses, reports, thus underlies not only the mental process of meaning but also the logical fact of implication.

Formal logic has mystified rather than simplified the study of reasoning, by asserting that it involves the passage from subject to predicate through a middle term, a universal, or a major premise. But the second premise, as offered in the syllogism, seems either strange or affected to the student. And rightly so, for it represents no present feature of an act of thought. It stands for the past context of which the "subject" was once a part. In thinking, present symbols function differently because of this past context. But the context is neither present nor revived.

In thinking we pass from cues to consequents "in the light of" but not "by the use of" past contexts. The major premise is, psychologically, a bit of superfluous baggage. Its place is not in the act of thought but in history, in the biography of the thinker. The syllogism is, therefore, neither an adequate story of "how we think" nor a model of "how we ought to think." It may be impressively used in the conviction of the unthinking who pose as reasoners and mistake for reason the play of rhetoric. It may be used as a pedagogical rule of thumb, a fossil map, to guide teachers in their efforts so to dispose their pupils' lives that reasoning may emerge. It is at most but a post-mortem verbalism or diagram, symbolically commemorating an act of thought which once lived. It erects

monuments for the various influences, past and present, which were factors in determining the way in which thought once traveled.

We may, however, translate into psychological terms the features which the syllogism commemorates. Thus translated the "subject" of the minor premise and of the conclusion is a present cue, detail, or stimulus. The "predicate" of the major premise and of the conclusion is an instigated consequent or report. The "middle term," which is the predicate of the minor and the subject of the major premise, is the past context, for which the present detail functions. The whole is not something more than its parts, but just these parts as related.

Socrates is a man.
All men are mortal.
Therefore Socrates is mortal.

Thus reads the immortal syllogism. But judgment and inference, as we have seen, are only reports of the meaning of signs. "The humanity of Socrates is a sign of his mortality," is all that is involved in the classical syllogism. The problem of validity, of the truth or error of conclusions, is, however, a practical or logical affair. So also, in most respects, is the consideration of "fallacies." Truth and error are ultimately matters of empirical verification.

But fallacies have also interesting psychological aspects. They involve the factor of *sagacity,* which we have hitherto purposively refrained from discussing. Both learning and sagacity are involved in that eminently practical phenomenon which we call intelligence. We shall be ready for this topic only when we have dealt with certain other psychologically vital themes, notably that of *attention.*

CHAPTER XXI

THE PHENOMENA OF ATTENTION

THE CONCEPT OF ATTENTION

It will be well to remind ourselves, in undertaking an account of the psychology of attention, of certain "general redintegrative laws" discovered in an earlier chapter. These laws briefly indicate certain of the phenomena of attention, as the term is commonly employed. Combining some of them into single statements, these laws, separately given on p. 49, are as follows:

Laws 4 and 9. Some details of an antecedent context have special instigative potency, and some contexts endow their details with special potency.

Laws 5 and 6. A detail's potency is a complex resultant of many special determinants, such as prominence, temporal position, contextual inclusion, recency, frequency, and concurrent details.

Laws 7 and 12. Stimulating details may reënforce or inhibit each other, and consequents may combine or synthesize, producing patterns of compatible features.

Law 8. Each consequent comes in time to be an expression of the total past life of the system in which it occurs.

So many things go by the name of *attention* in current psychology that it is not easy to discern their common features at a glance. But the phenomena classed under that term have signal importance in mental activity. We need their exposition now, as a prerequisite to the description of intelligence, control, and decision. In other chapters we have usefully employed the method of first surveying the diverse facts to which a term is commonly applied, thus arriving at suggestive principles of synthesis. By this method also, we may hope to achieve a systematic account of attention. We begin, there-

fore, with an array of observations which may not appear obviously related. At the end certain actual relationships will be pointed out and a more summary statement given of the facts of attention.

HIERARCHIES OF POTENCY

We have already observed, in the organization of purposes, the presence of a hierarchy of typical or individual human urges. Thus it was remarked that the common fears of men are dominant over ordinary lust, and this, in turn, is stronger than the average degrees of shame.

We have also noted the depressing or invigorating character of various feelings and emotions. Both the genetic account of Darwin and the emergency explanation of Cannon stress the relation of emotion to overt action. Situations or stimuli provoking emergency emotions (such as rage) or heightened organic states such as excitement, curiosity, enthusiasm, competitiveness, acquire special vividness thereby. For there is added to them the stimulating effect of their emotional consequents or feeling tone. Gloom and despair, on the other hand, are depressing. Nevertheless, stimuli arousing them will be prepotent in some ways over neutral stimuli of like intensity.

In the same way, in any animal, stimuli arousing instinctive mechanisms are more effective in evoking their appropriate consequents. Neutral stimuli, those for which no native response is adapted, may remain relatively inadequate. Such relations of prepotency are closely involved in attention. We may first of all note the presence of such facts as prepotency, facilitation, and inhibition in the behavior of simpler animals, and in the case of the more or less mechanical reflexes.

In the behavior of very simple animal forms, definite hierarchies of potency are observed among stimuli. Sometimes the priority of one stimulus renders another ineffective for the moment. Thus in Paramecium, priority of contact reaction prevents response to ordinary changes of temperature. Unusual changes of temperature, however, are prepotent over even prior contact reactions, and moderate changes of temperature, if given priority, interfere with the contact reaction.

Certain water insects ordinarily show pronounced reaction to changes of light, advancing toward the more illuminated region. But if such insects are cleaning themselves, or feeding, or if a number are assembled close together, this positive response to photic stimuli fails. The earthworm shows the reverse or negative response to light, but fails thus to respond if feeding or mating. The Irish terrier, when scratching himself, fails to respond to the ordinary signals of the trainer. But especially vigorous or repeated signals have right of way over the scratch reaction. Washburn, after Gamble and Keeble, cites the following observations.

In the turbellarian *Convoluta roscoffensis*, light is victorious over heat in determining reaction. The animals in their positively phototropic phase will remain in the heated light end of a vessel until they perish. Light and gravity are more nearly balanced in their effects. Convoluta is negatively geotropic, yet if the brightest region is below the surface, the animals will go there. But if this region is only a little brighter than the surface, they will stay at the surface, gravity dominating.[1]

INTERRELATION OF REFLEXES

Instructive studies of the relations of reflexes in experimental animals bear definitely on some of the phenomena of attention. Many such studies have been reported and interpreted by Sherrington.[2] Some of the most relevant points may be here recapitulated. In the "spinal dog," with brain dissociated by sectioning of the spinal cord, the reflexes appear in relatively simple and mechanical form, unmodified by higher brain activities.

In the "flexion reflex," gentle pinching of the foot results in bending of the leg in all its joints. The response to light touch on the skin of the chest is the "clasping reflex" of the forelimbs, which is said to be absent in the normal dog except

[1] M. F. Washburn, *The Animal Mind* (copyright, Macmillan Company, 1913; reprinted by permission).

[2] C. S. Sherrington, *The Integrative Action of the Nervous System* (Yale University Press, 1906).

in the presence of the female at breeding season. In the "scratch reflex," tickling the side of the body brings the hind leg of the side touched up to the body with rhythmical brushing or wiping movements. The "extensor thrust," a downward push of the foot, appears in response to upward pressure on the sole. When the animal is suspended with hind legs dangling, the weight of the legs is a stimulus to the "stepping reflex" or "marking time" response of the legs.

Some reflexes cease with their stimuli. Others outlast their stimuli, as in the scratch reflex. Others are definitely patterned in time, regardless of the duration of the stimulus, as in winking. Sometimes the force of a reflex varies with the intensity of its stimulus; elsewhere the reflex is the same for all potent stimuli. After excitation, reflexes show "refractory periods," during which they cannot be elicited. In some cases, as in scratching and coughing, a continuous stimulus produces rhythmic reappearance of the reflex, at a rate determined by its latent time and refractory period.

The extent or diffusion of a reflex effect may also vary with the intensity or locus of the stimulus. Thus "pinching the foot of the decerebrate cat lightly, evokes only flexion; a firmer pinch causes the head to turn and the jaws to snap; a still stronger stimulus may produce locomotive reaction and a snarl." This diffusion involves only compatible reflex elements. Some reflexes are excitable by various stimuli. Thus in the human being the Babinski reflex, present in the foot in certain abnormal adult conditions and ordinarily present in early infancy, may respond to stimulation of sole, ankle, outside of foot, or pressure of the calf.

Now such reflexes exhibit many relations of prepotency, inhibition, and reënforcement. Thus, according to Sherrington, "When one muscle of a pair of antagonists is excited reflexly, the opposing muscle is simultaneously deprived of whatever contraction it may have." This is inhibition, and it suggests that a reflex effect is actually a fairly complex pattern activity, involving other effectors (muscles, glands) than those that overtly change.

When nearly simultaneous stimuli lead to incompatible con-

sequents, the result, in such reflexes, is not an average or compromise. There may be delay or complete inhibition of both responses. Or one stimulus may have right of way, depending either on priority or native prepotency. Thus, in general, "protective" reflexes are prepotent over "postural" or "attitudinal" ones.

Moreover, two compatible stimuli, each too weak to evoke independently its appropriate reflex, may be summated and thus reënforce each other. If they tend toward the same reflex, they may jointly elicit this reaction. Even stimuli to different reflexes may facilitate each other. Thus auditory stimulation reënforces the leg reflexes. In man, a loud sound, or the clenching of the fist, facilitates, for example, the knee jerk.

RELATIVE COERCIVENESS OF TOPICS

If an eager friend engages one in conversation, near two other people who are engaged in equally animated or in furtive discussion, it is difficult to abide exclusively by the one line of talk. When some one kindly offers to read a poem at the bedside, the patient frequently comes back with a jerk from side excursions into fancy or memory. When spring days come, the lure of outdoor sounds and odors is often prepotent over the cues of duty, or the effective stimuli of winter ambition.

Pains, even when mild, often have things their own way, in ruthless disregard of more conventional events and stimuli. Intense, moving, novel, large, colored, contrasting, and "favorite" stimuli, as well as "danger signals," deflect the course of other pursuits. Topics once lacking in appeal become absorbing once we have learned their manifold implications and acquired a background adequate to their appreciation, that is, when they become meaningful.

Again, it is a commonplace that familiar objects in strange contexts have unusual effect upon our consideration. Events congruent or relevant to current activities also have a special effectiveness in determining conduct and thought. Thus Jastrow writes:

> Some years ago I became interested in cases of extreme longevity, particularly of centenarianism, and for some months every conversation seemed to lead to this topic, and every magazine and newspaper offered some new item about old people. Nowadays my interest is transferred to other themes; but the paragrapher continues quite creditably to meet my present wants, and the centenarians have vanished.[8]

Titchener suggests that some qualities are natively coercive.

> There are certain pains, by no means intensive, that are nevertheless urgently, insistently, importunately clear,—pains that we "cannot get away from" by any ordinary distraction of attention. There are certain organic complexes, also, which in my own experience have this power to compel attention; they are intimate, worrying, wicked things. The taste of bitter, the smell of musk, the sight of yellow belong, for me, to the same category; the least trace of them fascinates me. No doubt there is here a wide range of individual differences.

Even mechanically weak processes, such as those constituting ideas, may outweigh intense sensory impressions in the control of thought and conduct. All that is required is that they possess sufficient *interest*. This means that they function for past contexts of vital significance or are colored by strong feeling and emotion. The absent-minded man, wrapped in reverie, reminiscence, or reflection, is oblivious to the high energies of light and sound that beat upon his sense organs. His attention, we say, is directed elsewhere.

Mere words, seen or heard, such as "Danger!" "Fire!" "Police!" "Help!" may dominate over the crash of wreckage and the roar of thunder. Words might even be arranged in an approximate hierarchy according to their relative potencies as cues to action. Slight variations in vocal quality, enabling the recognition of the identity of the speaker, also add their determination to the relative potencies of words. Even the Irish terrier, who runs through our text, has come to heed a man's voice more promptly than a woman's.

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[8] Quoted, with the following paragraph, from E. B. Titchener, *The Elementary Psychology of Feeling and Attention*, (copyright, Macmillan Company, 1908; reprinted by permission.)

DEGREES OF CLEARNESS OR VIVIDNESS

It will be observed that in the foregoing account of the degrees of potency, we have gradually shifted from objective effectiveness to subjective prominence; that is to say, events vary in potency not only in their instigation of movement, glandular secretion, objectively observable adjustment. They also differ in their instigation of subjective sequences, such as the processes of identifying, recognizing, feeling, and thinking. In the objective field, dominance is called *effectiveness*. In the subjective field it is called *vividness* or *clearness*.

Events which are vivid or clear are subjectively effective. Their features are definite and identifiable; their details are notable and namable; their pattern and organization are conspicuous; they dominate in the instigation of subsequent processes. Such events are capable of precise, accurate, and confident report; they are, therefore, said to occupy the focus of consciousness. In so far as we identify consciousness with report, we may say that clear events are those which determine consciousness.

A simply stated but apt paragraph from Titchener may be quoted on this point. He writes:

Let us see . . . how things look when we try to *describe* attention, without making any effort to interpret or explain it. Suppose that, as I sit writing this paragraph, I am called to the telephone, or am interrupted by the entrance of a friend. My attention is thus diverted to a new object. What happens? Something happens that we can only describe as *a shift of the vividness of our mental processes.* A moment ago, my psychological ideas were vivid, set (as it were) in the focus of attention, while all other ideas and perceptions were dim and marginal; now the incoming ideas—my friend's business or the subject of the message—drive to the front; they in their turn become vivid and focal, while the psychological ideas, just lately central and dominant, fall back, along with the perception of my sensory suroundings, into the dim background. *Attention, therefore, if we consider it purely descriptively, hinges not upon mental activity, but upon the vividness of mental processes;* and the state of attention may be described as a certain pattern or arrangement of mental processes; whenever our experience shows the pattern of vivid center and dim background, of bright focus

and obscure margin, then we have attention before us. *What then is vividness?* . . . Vividness is one of the universal aspects or attributes of sensation. Just as all sensations vary in intensity, so do all sensations vary in vividness.[4]

Much discussion has centered about the topic of the number of observable degrees of clearness. Some psychologists are inclined to distinguish sharply between clearness and obscurity, as they might also between conscious and unconscious. Others with arbitrariness name three or four or five levels of subjective effectiveness. Others suggest that "consciousness shades off from high light to dim background," with no sharp differentiation of degrees.

It seems unlikely that if clearness were an all-or-none affair, there should be so much doubt about the degrees of vividness. In the case of the simple reflexes, to approach the matter of potency objectively, it is only in the case of the mechanically isolated or the most elementary component acts that the all-or-none appearance occurs. More elaborate patterns vary in intensity and spread, according to the features of the stimulus and the various modes of reënforcement and inhibition. Hence, so far as objective effectiveness is concerned, it seems that except in highly artificial or abstracted conditions, there are continuous variations of effectiveness, numerous "degrees."

It is, perhaps, unsafe to infer, from objective effectiveness, the facts of subjective vividness. But the situation here seems quite the same. Only in the case of extremely artificial elements does vividness assume the sharp two-level division. In all reasonably elaborate patterns there are numerous and not sharply differentiated degrees of clearness. These show themselves, as a continuum, in the various degrees of completeness with which such patterns may be reported.

There is some reason for supposing that individuals differ in this matter of degrees of clearness, although the facts have not been very well established on a measurable basis. Ordinary observation of daily activities of human beings at least

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[4] E. B. Titchener, *A Beginner's Psychology* (copyright, Macmillan Company, 1915; quoted by permission), p. 91.

shows certain extreme types, between which it is probable that the rest of us are distributed according to the rules of the normal probability curve. At the one end is the individual who is quite obsessed and carried away by a particular cue or stimulus presented, with relative disregard of other items. This often means disregard of the current context in which the detail appears. The dominant cue has right of way and all other possible contributors are inhibited.

On the other hand, or at the other extreme, is the individual who is so activated by all the details occurring at the moment that "concentration," that is, special dominance of one cue, seems impossible. The former individual is "obsessed." The neurotic soldier of our earlier chapters is a good example. Current contexts had little weight if a significant detail of the battle scene were present. If concurrent details had been moderately effective, the neurotic symptoms would have been automatically alleviated. The latter individual is "scatter-brained" and lacks that hierarchy of potencies which constitutes a well integrated personality.

THE CHARACTERISTICS OF SAGACITY

The most effective and best organized constitution is clearly neither the "obsessed" nor the "scatter brained." It is, instead, the sagacious and discriminating. This means openness to a large field of stimuli, with organized potencies among the elements discerned therein. Attention, as so far considered, is a description of discrimination but makes no provision for sagacity. In our present ignorance, about all we can say is that individuals differ markedly in a characteristic to which we may apply that name. Openness to all the details of a present context is as important as is the establishment of redintegrative effectiveness on the part of the several details. In effective mental activity, *all* or *many* concurrent details, in the light of their past contexts, conspire in the instigation of the consequent. This makes such a consequent appropriate to the total present situation, in the light of the whole past history of the individual.

Thus the "meaning" of a word should be determined not merely by the past situations in which it has been a detail, for these are many. It should also be determined by the "present context," the accompanying words, appearing concurrently with it. Reading is such a complex function that both past learning and present alertness are required for comprehension of what appears on the page. Space perception, again, that relies on but a single available cue, is likely to go astray. Adequate space perception rests upon a *joint interpretation* of all the clues which the situation affords, with due discrimination of their relative importance or reliability. Individuals differ remarkably, and we may say, inexplicably, in capacity for such synthesis.

The good observer, wrote Mill:

> is not he who merely sees the thing which is before his eyes, but he who sees what parts that thing is composed of. To do this well is a rare talent. One person, from inattention, or attending only in the wrong place, overlooks half of what he sees; another sets down much more than he sees, confounding it with what he imagines, or with what he infers; another takes note of the *kind* of all the circumstances, but being inexpert in estimating their degree, leaves the quantity of each vague and uncertain; another sees indeed the whole, but makes such an awkward division of it into parts, throwing things together in one mass which require to be separated, and separating others which might more conveniently be considered as one, that the result is much the same, sometimes even worse than if no analysis has been attempted at all.

William James, in his famous chapter on "Reasoning," makes much of the factor which he calls "sagacity," defining this as the ability to note just *what parts* are "embedded in the whole" before one. Reasoning he defined as "the substitution of parts, and their implications or consequences, for wholes." Especially vivid is his account of the necessity of noting, not just *any* parts, but the *vital* ones in the light of the whole context. We cannot forbear quoting these lines.

> My thinking is first and last and always for the sake of my doing, and I can only do one thing at a time. A God, who is supposed to drive the whole universe abreast, may also be supposed, without

detriment to his activity, to see all parts of it at once and without emphasis. But were our human attention so to disperse itself we should simply stare vacantly at things at large and forfeit our opportunity for doing any particular act. . . . We cannot aim "generally" at the universe; or if we do we miss our game. Our scope is narrow, and we must attack things piecemeal, ignoring the solid fulness in which the elements of Nature exist, and stringing one after another of them together in a serial way, to suit our little interests as they change from hour to hour.[5]

The point for the moment is that individual creatures vary enormously in their "narrowness of scope." One is able to "size up the whole situation," thus sagaciously noting how all its concurrent parts bear upon the outstanding feature. He thus avoids being either obsessed by outstanding details or scatter brained in the presence of them all. Some of the factors making for such individual differences can be indicated. One of them is learning, whereby parts otherwise ignored acquire significance. Learning is also responsible for the fact that, for some, trivial cues of the momentary context are nevertheless potent, freighted with the significance of their past contexts. For others these are meaningless cues, slighted because of their intrinsic triviality, their feeble mechanical intensity. But there are undeniable native differences in this capacity for cue reduction, in the sensitiveness to subtle cues, and also native factors making for differences in the reportable scope of what the social consensus testifies goes on at a given moment. In a later chapter we shall see the way in which these two factors, learning and sagacity, combine in the production of the attribute which we name "intelligence."

LIMITATIONS OF SCOPE

Restrictions in the scope of events dealt with vary also with the complexity or completeness of the report that is required by the motive or purpose. Thus one may expose momentarily in the visual field of an observer a number of different and

[5] Wm. James, *Principles of Psychology*, Part II (Henry Holt & Company, 1890), p. 333.

variously colored letters, on a neutral background. The brevity of exposure is such as to limit the process of report to a single sequence or act, and the materials presented may occupy the whole field of view.

In such a case, the items reported vary in scope or number with the type of observation demanded. If the subject must name the individual letters and indicate their respective colors, only two or three items will be covered correctly by such report. If he is required only to name the letters, the scope will extend to at least four or five items. If required only to count, numbers of letters up to seven or even nine are correctly reported. If required only to indicate the point in an increasing series at which definite pattern arrangement ceases to appear, thirteen or fourteen items may be thus noted. While if required only to report the point where the visual field breaks into two discriminable degrees of clearness, sixteen to eighteen items may be thus included in one clearness level. The range of events reported is thus limited by the completeness and detail of the report. These various limits have been called by such names as the span of attention, the range of report, the cognition scope. It will be recalled that in the case of memory also definite "span limits" were noted.

FLUCTUATIONS OF QUALITY AND PATTERN

There are somewhat analogous phenomena in the behavior of sensory objects, such as pains, afterimages, minimal sounds, faint lights, incompatible qualities, and the pattern and arrangement of loosely organized objects. But here the limitations are of time rather than of number. Thus the soft ticking of the clock does not appear uniformly. It comes and goes, much as the faint stars disappear and reappear in the field of view. Many aches and pains are rhythmical in their appearance or in their intensity. Afterimages and "mental images" are equally unstable.

Looking at oilcloth or linoleum markings, such as those roughly represented by the accompanying group of circles in Figure 29, the elements arrange and rearrange themselves in

varying patterns. Or in the pile of blocks in the illustration in Figure 30, the lines and areas are so changeably grouped from moment to moment as to make the very number of apparent cubes vary, correspondingly.

A somewhat analogous phenomenon appears in retinal rivalry. Before one eye (as on a stereoscope slide) is placed a green patch, and before the other eye a red patch, in corresponding locations. With both eyes open the two patches coincide, or may be made to do so, by the proper optical divergence. Will the patch then be seen green or red? It cannot be both at the same time. Ordinarily it is alternately green and red, or part green and part red, or slowly changing from one to the other color.

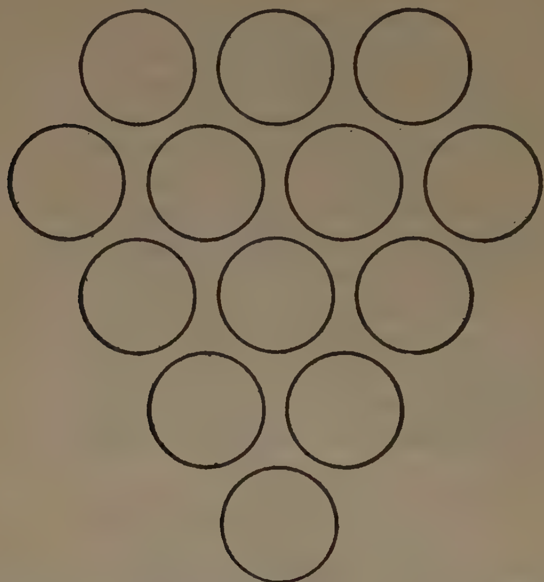

FIG. 29.—THE CIRCLES ARRANGE AND REARRANGE THEMSELVES IN VARYING PATTERNS.

Neither color can be "held" permanently, although it may be in various ways prolonged, as for instance by "thinking of it" or by refraining from eye movement. And if other

features are added to one patch, such as marks or diagrams thereon, the color so marked or enhanced may persist longer. Or the diagram may remain while the colors fluctuate about it. In such ways, by varying the brightness, color, intensity, or configuration, one field may be given prepotence.

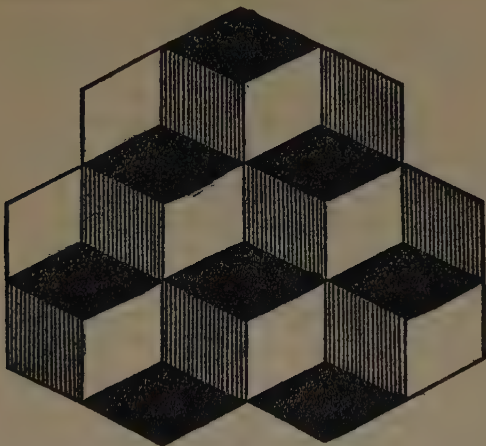

FIG. 30.—THE AREAS APPEAR IN VARYING ARRANGEMENT, THE NUMBER OF CUBES CHANGING ACCORDINGLY.

OBJECTIVE AND SUBJECTIVE ASPECTS OF ATTENTION

Objectively regarded, attention is the focal organization and restriction in scope of an animal's activity. The creature is *one*, an individual. Response to one stimulus, in the way of activity, thus involves response to others by way of inhibition. Even the neuromuscular mechanism of the dog's leg is so integrated that it functions as a unit, one muscle is inhibited when its antagonist is thrown into contraction. Any other arrangement would nullify action.

Now in a general way the whole activity of the animal is thus organized. Activity in one direction inhibits other tendencies. In order to see, the creature must *look*, and this involves adjustment of sense organs, the general musculature, and the general internal activities in ways most favorable for

seeing. In order to hear, the animal must *listen,* and this again involves the characteristic arrest and immobility that is an objective sign of such attention or constitutes it. In a sense then, restriction of scope and focal organization are one fact—the fact which we call attention, when objectively regarded.

Subjectively reported, the picture is no different. Nature appears "piecemeal," and the mechanism of naming and report is a functional unit. When one event is being reported, others are not. When one quality is introspectively dominant or clear, others are varyingly obscure. The various degrees appear perhaps only because after all, in man, there are *several* instruments of report; naming is one, posturing another, gesturing a third, and the flow of symbolic imagery still remains possible. So that attention is not after all strictly an all-or-none phenomenon. Neither, for that matter, is it in the lower animal, except in very simple forms or under artificial conditions, as in the case of the "spinal dog."

It should be emphasized, moreover, that the "event" which is introspectively dominant is by no means a simple and irreducible quality or attribute. It may, instead, be a complicated pattern or configuration.

> What we call the object, the simple existing thing [writes Pillsbury], is not so much determined by its physical characteristics as by the use to which it is put, and the attitude of mind at the time they are perceived. A thing may just as well be large as small, complex as simple. It is equally unitary at the moment of perception, no matter how many elements go to make it up. It is as easy to recognize a landscape as any single grain of sand that contributes to some simple feature of the view. If aspects or attributes, sensations or things, to speak metaphysically, psychologically and popularly at once, have been used together, or have frequently come into consciousness at one time, they come to be regarded as a single object, they become isolated from everything else, and when they come to mind again they are treated as a unit.[8]

The very fact that a pattern of quality and relations can be described as characteristic of attention, shows the absence of

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[8] W. B. Pillsbury, *Attention* (copyright, Macmillan Company, 1908; reprinted by permission), p. 66.

sharp distinctions between clearness and obscurity. In the simplest case (sometimes called primary attention), some intrinsic feature of the stimulus is responsible for its clearness—its loudness, suddenness, novelty, or other features depending on mechanical effectiveness or on appeal to native, instinctive response. The introspective pattern comprises the qualities that are first of all dominant, plus organic and intellectual feelings and the rather mild kinæsthetic qualities correlated with the motor adjustments, postures, and general activities concerned in the response to which the cue or stimulus leads.

In another situation, conflict may arise between two tendencies, as for example when ideas compete for dominance with intrinsically potent immediate stimuli. In such a case, kinæsthetic and feeling qualities increase in prominence, as efforts are made to effect adjustments favorable to the mechanically feebler but more meaningful object. The feeling of effort and struggle, and the general unpleasantness of conflict between incompatible tendencies give this situation (sometimes called secondary attention) characteristics of its own. This is the situation when attention is dictated by "a sense of duty," for example, rather than following the line of least resistance or the line of immediate or native interest. Depending on the degree of success, in such a struggle, the primary form of attention supervenes as acquired potency and interest come to take the place of native coerciveness.

The clearest account of these patterns of attention, and their genetic course, is given by Titchener. Thus he concludes:

> Attention appears in the human mind at three stages of development: as primary attention, determined by various influences that are able to produce a powerful effect upon the nervous system; as secondary attention, during which the center of consciousness is held by a certain perception or idea, but is held in face of opposition; and lastly as derived primary attention, when this perception or idea has gained an undisputed ascendency over its rivals.[7]

[7] E. B. Titchener, *A Text-Book of Psychology* (copyright, Macmillan Company, 1910; reprinted by permission), p. 275. See also his *Elementary Psychology of Feeling and Attention* (Macmillan Company, 1908).

Both objective and subjective aspects of attention may be illustrated in the case of the audience. Objectively its attention is measurable in terms of its restlessness. When the audience is "attentively listening or looking," general movements are reduced and quiet prevails. As it "loses interest" and "attention wanes," rustling, shuffling, coughing, and miscellaneous adjustments multiply.

Subjectively, the members of the audience would give a similar report. They would show that there was but little going on for them except the discourse or the spectacle. Even memory and fancy would be in abeyance, or only obscurely present and then in some connection with the performance. The more attentive, the better able they would be to report upon the theme of the speaker; the less attentive, the more miscellaneous, unrelated, and heterogeneous the events to which they could testify.

No doubt there is also a very elaborate play of neural activities, which it is the problem of physiology to describe. Reënforcements, inhibitions, connections of various sorts have been conjectured as the "neural basis" of attention. And in the glandular, vascular, and other organic systems correlated organizations may also be surmised. Some of them have even been experimentally demonstrated and measured. But no single and reliable index of presence or degree of attention has yet been devised, in terms of the activity of any one organ or structure, any more than one material has ever been isolated as the sole instrument of imagination, memory, or thought.

THE DETERMINANTS OF ATTENTION

The correlates and conditions of that limitation of scope and organization of potencies which we call attention, we have seen to be many. "Control" of attention necessarily involves also direction of such correlated factors. The education of attention implies the training or modification of some or all of these factors. The applied or functional psychology of attention is, therefore, most of all interested in the nature and possible manipulation of such "conditions of attention." We

may roughly indicate the various general fields in which they lie.

1. *Native influences,* which can be controlled only in the sense of knowing and utilizing them. Thus the structural organization of the reflexes is natively determined. Many stimuli and relations of potency also have an "instinctive" basis. Some of the factors underlying individual differences in scope and sagacity are also determined through heredity, so far as we now know. In this field control consists in discovering what the native tendencies and limitations are, and making the most of them. The advertiser does this, for example, in selecting for his appeal devices which have high intrinsic or primary potency—motion, color, novelty, contrast, and appeal to "instinctive interest."

2. *Motor and physiological concomitants* are summarized by Pillsbury in the following words:

> The muscles of the sense organs contract to give the greatest possible effect to the stimulus. The voluntary muscles of limbs and trunk undergo contractions that have previously been found useful under stimulations of the same kind. There is a diffuse contraction of many voluntary muscles without reference to the nature of the stimulus. The respiratory and circulatory processes are profoundly affected.

These concomitants in part precede, in part accompany, and in part follow a particular attentive picture. In so far as they precede and accompany it, they seem to contribute support and facilitation to the dominant activity, if only by inhibiting interfering activity. In the control of attention these concomitants may be to some extent capitalized. Thus the attention of the audience is facilitated by seating them facing the performance, and by any devices calculated to eliminate that form of restlessness which is a concomitant of inattention. Even relatively mechanical stimuli, such as gesticulation and variation of intonation, calculated to turn the sense organs in a given direction, may be favorably employed. And brief periods of rest and relaxation, for the elimination of fatigue, work in the same favorable way.

3. *Contextual influences*, as we have seen, are determinative even in lower animal forms and in the mechanical reflexes. Incompatible stimuli interfere, inhibit, and reduce. Compatible stimuli facilitate and reënforce. Hence elimination of competing appeals is a technique of control, as is also constellation of appeals with a common pathway of expression. The audience attends with difficulty if steel-riveting is going on in the neighborhood. What should be primary attention is here reduced to the secondary level, where derived interest must struggle against native potency. In popular terms, this technique of control of concurrent stimuli is known as the prevention of distraction. We have already illustrated, in the case of the stereoscope experiment, the way in which the one visual field may be prolonged by the addition of some enhancing feature such as a mark or diagram.

4. *Experiential influences* have no mean power as determinants of attention, but they are so numerous that a textbook of psychology is largely concerned with their elaboration. We have seen that the field of one eye, in the stereoscope, may also be prolonged, given added dominance or temporal scope, by "thinking of it" in advance. Thus Pillsbury concludes: "If you expect to see the red, and have a distinct memory image of the red, you will see it first, and will continue to see it until fatigue for that process sets in, when the green will supplant it." Expectation, a favorable subjective and attitudinal context, is, therefore, one of the "subjective determinants." This explains why we must look in order to see, why we see better that for which we are looking, and why training and familiarity (the acquisition of meaning through participation in former contexts) is so effective in determining the scope and subtlety of report and observation.

Established sequences, on the basis of learning, operate as do native or instinctive tendencies. Interest and concern which come as the result of education may rival the primary potencies of stimuli. Faint and subtle cues, ideas, thoughts, and trivial signs, come through the technique of meaning to be as dominant in the field of observation or the field of overt conduct as grosser objects. If reënforced by feeling and emo-

tion (interest) they may vastly outweigh the primary qualities and objects. Secondary attention, once established, even with effort, becomes "derived primary attention." The elaborate processes of perception, the rich play of imagination, the validity of memory, and the effective technique of thought and reasoning, depend in fact on the determination of attention by subtle cues of meaning, as contrasted with the mechanical cues determined by heredity and native structure.

CHAPTER XXII

VOLUNTARY ACTION AND DECISION

THE PROBLEMS OF DIRECTION AND CHOICE

We have already unavoidably dealt with some of the features of volition and decision, in our accounts of (*a*) learning, (*b*) reasoning, and (*c*) attention. For in learning we have observed the way in which an act, formerly aroused only by an elaborate situation or context, comes to be touched off by some slight or reduced cue. Thus when the piano composition is "learned by heart" it can be produced "at will." Its cues are well established, quite reduced, and simplified; consist of details occurring within the organism (kinæsthetic events of successive movements) and hence readily available; and the various steps are integrated and coördinated into a pattern.

In the case of reasoning, we found that the various alternatives or hypotheses suggested were not equally useful in alleviating the motive. Activity persisted until such a remedial hypothesis did occur, whereupon, the motive being allayed, the activity ceased. This amounts, therefore, to a *choice* between the alternatives. In a sense, they decided among themselves, since adoption consists merely in appropriateness to the motive. Rejection of one conjecture consisted simply in continued manipulation, the development of further alternatives. And we saw, in the introspective accounts, how each of these alternatives was reënforced by whatever associates it was capable of provoking, whatever allies it could summon, in so far as these were compatible therewith. The rôle of the motive thus makes such selection a voluntary affair.

In the case of attention, we have seen the way in which one reflex, pattern, or topic is given precedence over others, ac-

quires right of way, and thus becomes "dominant." This again, may be described as a *choice*. Extraneous increments were here important: adding a mark to one colored field gave it dominance over the other; increasing the intensity of one stimulus gave its reflex dominance over those of rival cues. Additions, through adaptation of sense organs and the general musculature, favored the reception of one stimulus. Or past context and feeling tone aroused by the significance of slight cues, gave them right of way over stimuli mechanically more intense.

In the study of learning, then, we have been introduced to the technique of *voluntary control*, and in the development of speech this process was also exhibited. In the study of reasoning and of attention, we have been introduced particularly to the phenomena of *choice* and *decision*. Our further account of these mental phenomena may, therefore, consist chiefly in further illustration of them, with emphasis on the mental process or mechanism whereby control is gained and decision effected. We shall find nothing unique in this field, nothing that has not already become familiar in the development of other topics. But the points must be explicitly elaborated again, because of the superstitious notions that have sprung up in connection with the facts of control and decision.

Certain simple principles may first be stated, all of which have been emphasized already or are thoroughly consonant with what has preceded. For the sake of clearness these may be separated as independent propositions, although they are actually closely interrelated.

1. Every consequent must have a cue. Effects, that is, must have causes; movements result only from stimuli; changes in either the objective or the subjective field imply antecedents. Things do not "just happen"; they are produced, evoked, instigated. The determination of acts must, therefore, be sought in the cues to those acts, actual antecedent events, not in "spontaneity" nor "the soul" nor "the will" nor in the inexplicable outcroppings of "energy."

2. Some consequents are "natively" connected with their stimuli. We can observe the fact of connection and hope to

identify both the connected items. But for explanation of the particular connectedness we can only turn to the biologist, who in our time at least, seeks to attribute all such cases of native potency or dominance or connection to "natural selection."

3. In other cases the connection is definitely and often observably "acquired," through the techniques of learning. Thus impotent cues, for a given connection, become potent if they are parts of larger stimuli which become effective (natively or through learning). Or even if only concurrently applied, as in the "conditioned reaction," cues once impotent acquire instigative effectiveness under the general part-whole plan. Here also there is, therefore, something which might be called "selection." But it is ontogenetic, not phylogenetic.

ACTIVITY ORGANIZATION AND DEVELOPMENT

The course of development of voluntary control may be conveniently, though only in part experimentally, observed in the early days of infancy, where it clearly follows the fairly simple redintegrative paradigm. At birth the human being, for example, appears chiefly as a sensorimotor mechanism, with many sensory avenues and relatively few *established* modes of motor response. Each stimulus applied provokes varied and irregular movements, which, with the definite reflex and the vague emotional patterns, come to constitute the basis for later organizations. We have already traced the course of voluntary control in the case of speech. We may now indicate it again in such manual and other bodily activities and coördinations as rapidly develop.

The earliest observable reactions are of three forms. There are the definite reflexes and emotional patterns; there are "random movements," which may be reflexes with obscure stimuli or the results of combinations of stimuli; and there is the characteristic *checking* of activity by extra-bodily stimuli. Aside from reflexes and instinctive or emotional patterns, the earliest movements seem instigated chiefly by bodily stimuli, by processes going on within the organism. The

crying and restlessness thus occasioned may early show sudden *inhibition* by auditory, tactual, and visual stimulation. A common form of this inhibition is what we have already come to know as the attitude of attention. It is not a mere passivity, but instead a general tension and characteristic posture.

Early in development, extra-bodily stimuli (qualities in the higher senses), occurring concurrently with internal organic excitants, become connected with the ensuing motor response. This is the normal mental procedure; as parts of the antecedent context they become themselves potent to evoke its consequent. The rôle of internal stimuli thus diminishes and that of external stimuli becomes magnified. Subjectively, this means that qualities from the higher sense fields (sights, sounds, contacts) become substituted for lower sense qualities (pains, aches, hunger, bodily feelings) in the production of motor activity. Movements at first reflex and random thus become organized into patterns associated with particular outer stimuli. This is the first stage in the development of voluntary control—a shift from internal to external stimuli.

Such movement systems early become adapted to inner needs and to the satisfaction of vague states of discomfort, through the ways in which they manipulate objects in the environment or determine the activities of attendants. In this way they serve in the attainment of ends or results. In time, fragmentary and partial details of external situations are able to instigate adjustments formerly made to the total situation. *Other* incidental bodily needs and internal conditions, occurring concurrently with these details, may thus also become potent in new directions. Internal signs and clues of the need which the learned adjustment modified or removed thus become adequate stimuli to these very adjustments. An idea or symbol of the result is also effective. There is thus a second shift, now back again from external to internal stimuli. Movements are now made at will, that is, in response to inner stimuli which are symbols. This is the second stage, and constitutes the acquisition of voluntary control.

The process is extremely significant for psychology as well as for practical adjustment. First, the effective inner stimuli,

then the establishment of adequacy of concurrent external stimuli (from the higher senses), then the potency of new and concurrent internal stimuli, which are either needs or symbols of results—this series of shifts, underlying the attainment of voluntary control, occurs through the fact that partial or associated details of a situation become potent to evoke reactions originally consequent upon the entire stimulating situation. It is this potency of partial details which we have throughout emphasized as the fundamental feature of mental activity. It should, therefore, not be disappointing that nothing "new" is to be encountered in connection with control and decision, no mechanism not already abundantly exhibited in connection with many other psychological topics.

ACQUIRING VOLUNTARY CONTROL OF THE EAR

A much-quoted experiment on the acquisition of voluntary control is that of Bair, who chose several subjects unable to move the *retrahens* muscle of the ear (which in contracting and relaxing would wiggle the ear back and forth). All of these he then taught to move the ears, not only together, but alternately as well. Twelve of the subjects could make no ear movements at the start, two could move the ears slightly "when vigorously raising their brow."

Bair tried first to "give the subject the idea of the movement by means of artificial (electrical) contraction of the retrahens." By "idea of the movement" the investigator seems to have meant the presence of the kinæsthetic qualities, in sensory or imagery form, which *constitute* the movement as kinæsthetically known and *accompany* it as visually known. He sought to determine whether acquiring the "idea of the movement" was "sufficient to enable us to reproduce the movement." This would mean that the "imaged qualities and pattern" would instigate either the "sensory qualities and kinæsthetic pattern" or the "objective or visual movement," or both of them. The subjects were instructed to try to assist the electric current, by making simultaneous efforts to move the ears when the current was applied.

We are not told what these *efforts* consisted of, although one subject, quoted as typical, reports "It seemed like trying to do something when you have no idea how it is done. It seemed like willing to have the door open or some other thing happen which is beyond your control." Presumably the *efforts* consisted in verbalizations, such as "Move, ear!" or in eye movements toward one or another ear, or in visual imagery of moving ears.

If this part of the experiment had succeeded we should have analyzed it, redintegratively, as follows:

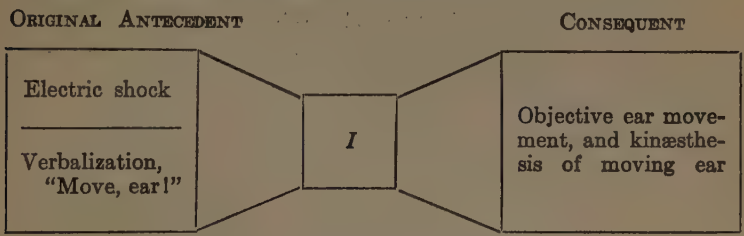

FIG. 31.—PRIMARY SITUATION.

SECONDARY SITUATION

As a matter of fact, this experiment did not succeed. The reason may have been that, as in the case of the conditioning of the dog's salivary secretion, as many as forty or more trials may be required to establish such potency for a concurrent cue. Whereas Bair used only "from ten to thirty" applications of the co-stimuli. Nevertheless, all the subjects did acquire control over the ear movements. The method found to be successful was as follows: In the stage where

voluntary movement just begins to make its appearance . . . the retrahens is always contracted by biting the jaws together or vigorously raising the brow. The ear was thus first reached by innervating a group of muscles over which one already has control. It was reached by making it one in the group. [This early stage] ended with a maximum contraction of the ear accompanied by a maximum contraction of all the muscles with which it was associated. [With repeated trial, after this a stage was reached where] the maximum of ear contraction could finally be effected without

raising the brow or innervating any other muscle than the one which produces the movement. The brow movement with which the ear was associated is gradually relaxed, until finally it is entirely eliminated and the ear can be moved independently of it. This is the important stage in the development of voluntary control. . . . The motor impulse, which was at first diffused throughout the group, is concentrated upon one part of the group, until that part is moved independently of the group of which it was originally a part.[1]

If we limit our account, as traditional psychology has tended to do, to the objectively observed "isolation of the single movement" from the group, we are left with no explanation of how this happens, except through vague references to "concentration," "restriction of attention," "analysis," and the like, which are after all "results" rather than "causes."

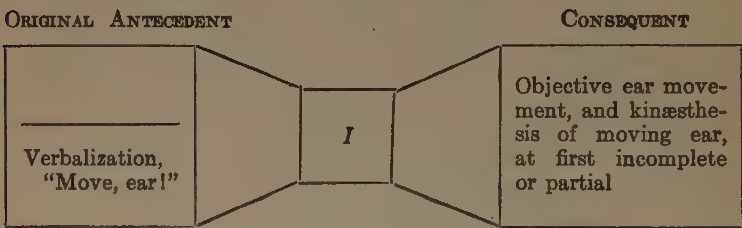

FIG. 32.—SECONDARY SITUATION.

We seem, however, to make some progress toward understanding if we consider the reduction of cues rather than the segregation of consequents. It is clear that the redintegrative paradigm represents what actually happened in the case where the voluntary control of the ear was acquired. What the initial stimulus was to the *joint consequent*, involving movements together of jaw, brow, and ear, we are not told. Whatever it may have been, it had already gone through a long process of reduction in the earlier history of these adult subjects. But it was still relatively gross, so gross as to implicate a whole array of muscular contractions, and the total gross cue was at the first stage required to move the ear.

In time, this stimulus became reduced so that only part of it was required for ear movement, so small a part that the

[1] J. H. Bair, "Development of Voluntary Control," *Psychological Review,* September, 1901, pp. 474-510.

movements of the other parts of the head and face were no longer involved or instigated by it. The ear was then moved *alone,* by a partial feature of its earlier stimulus. As practice continued, the ear was moved readily *at will,* that is, at the instigation of some easily producible cue such as the verbalization "Move, ear!" or some other equivalent symbol. The process even goes further so that this total but reduced cue is still further resolved into effective components, belonging to the respective ears. The ears are then moved alone, at will, and singly.

The process is thus actually explained, in the sense that it is shown to be a typical case under the general redintegrative law. A consequent becomes thereby capable of production by a detail of its former stimulus. It is of particular interest that Bair noted that parts of the cue initially not productive of the ear movement also came to produce it, that is *any part* of the total co-stimulus now tends to evoke the consequent. Thus he says in a footnote: "It is interesting to note that before the association was made between brow and ears the brow could be raised without moving the ears. But now, ever since the ears can be moved independently of the brow, *the brow cannot be raised without moving the ears.*" This observation shows very clearly what we have throughout maintained, that the "conditioned reaction" diagram is only half a description of what actually occurs. Originally the cue to ear movement involved also brow movement. Now the cue to brow movement also leads effectively and inevitably to ear movement.

In one part of his experiment, after ear control had been achieved, Bair instructed his subjects to *prevent* the movement in response to electrical stimulation. The idea or cue of the ear contraction had now been effectively established, and even when it occurred along with some symbol for "not," it moved the ear. That is, the intention to keep the ear from moving, in these subjects, led directly to an ear contraction. They "supposed" that they were preventing the contraction to electrical stimulation. Actually, instead, they at once contracted the muscle and held it thus. The cue to movement,

occurring even under negative instruction, was positively effective.

SELECTION AND CHOICE

In choice, the process is more complex, only by reason of the rivalry of alternatives. Choice presupposes that incompatible alternatives are already tentatively aroused, by appropriate cues or stimuli. If these are reflexes, or instinctive or acquired patterns of overt muscular action, the choice consists in a tipping of the balance of power of the two cues. If anything in the way of additional stimulation, or lessened stimulation, affects one or other cue with respect to its instigative power, corresponding lines of action are favored. Or if associated ideas, feelings, emotions, are aroused by either cue, these in turn add or detract, according as their own instigation reënforces or lessens either of the competing trends.

Reënforcement and inhibition, by new stimuli, or by immediate changes in the original stimuli, adventitiously or associatively aroused—these are the factors in choice. Choice and decision are, therefore, also matters of attention, and the determinants of attention are the criteria of decision. The choice is not between acts but between their cues. But among these cues may be some idea, image, or other symbol of the acts themselves. The cue that finally dominates attention will lead to its appropriate consequent, either now or in whatever manner or time contemplated in the rehearsal of alternatives.

Recall the picture of the distressed robin, described in Chapter XVII. As the bird sailed from the oak tree toward its nest, it encountered the human spectator on the porch. This was so powerful a cue as to interrupt the nestward trend and set up the flight of fear instead. As the bird receded, a point was reached (the dogwood tree) where the two cues were balanced. There the robin paused, moving neither toward nor away from the scene. And there it might have remained had other events remained unchanged. But this was not the case. If the spectator moved, the bird fled farther away, since a moving stimulus is prepotent over a stationary

one. If the fledgelings began to chirp in the nest, the lure of the nest was increased. The bird ventured nearer, since the cry of the young is an added stimulus reënforcing the general lure of the nest. Or merely through prolonged restlessness, the sight of the oak bough, a new and hence inviting perch, becomes increasingly potent. It breaks in upon the rivalry of the initial pair of stimuli and the bird flies to it. Thus it obscures the view of the spectator and reduces the potency of that cue, perhaps entirely eliminates it. But some cue, leading the bird nestward, is still active and now becomes dominant, and the "vicious circle" begins again. Here we have all the factors of choice in the case of the behavior of another organism, objectively regarded.

Referring to the introspective analysis of subjective choice, in the case of thought (p. 394), it will be seen that precisely similar processes occurred. But the reënforcements, inhibitions, and mutual relations occurred in "imagination"; they were symbolically represented rather than overtly present. Advantages of the two universities were "ideally" represented or "thought." Size, location, number of students, personnel of the faculty, and other "considerations," in turn, were brought to bear upon the two represented alternatives, until one outweighed the other and dominated in the attention pattern.

It is of special interest that even here the sign or act of decision was necessarily kinæsthetic. It took the form of a movement, although a symbolic one—nodding the head, extending the arm, and so on. Very often decision is just the production of such an act of appropriation or rejection, a motor occurrence, overt or symbolic. But the observations do not show this always to be the case. Sometimes the "act" of decision consists in the resolution of a state of doubt, the abolition of organic strains, the general rise of agreeable feelings. Or it may take merely the form of the vivid persistence of the symbol of one of the alternatives, the symbol for the other weakening and failing to appear in the field.

Sometimes it is said that choice and decision involve the identification of "the self" with one of the alternatives. Or it

is asserted that in choice a "fiat" is issued which puts the final stop to the rehearsal of the alternatives. Now "the self" is just that pattern of organic and kinæsthetic qualities, feelings, emotions, motives, and purposes, memories, and recognitions, which persists as a relatively continuous stream throughout waking life. Whatever involves movement, overt or represented, invokes thereby the "participation" of the self. Whatever arouses strong organic and intellectual feelings of assent, pleasure, and familiarity, thereby involves the self. The fiat, it appears then, is just this arousal of kinæsthesis or of positive feeling tone which persists. Securing the warrant of "the self" consists thus in fitting in with the motor activities or the conspicuous motives of the system.

In voluntary choice the cues are commonly symbols, although such choice may involve direct objects, such as foods, pictures, and the like. But under any circumstances, in voluntary choice the processes are capable of being reported by the observer (the actor). They are, therefore, said to be "conscious" acts. When I claim a decision as *mine,* this means that it is localizable among that general array of processes which I report as going on in nature, but which are inaccessible for the most part to other observers. The event is rooted in my habits, is definitely related to my present feelings, my memories, my dominant motives and purposes. The decision is, in one sense, made *by* the self, since the self *is* this organized system. In another sense, the decision is but a part of that total configuration to which the term "self" is applied.

For the terms "I" and "me" fluctuate constantly in their application, from one part to another, of such a system. Thus in such statements as: "He hit me," "I am a Democrat," "Show me the way," "I am hungry," "I fell downstairs," "I know my own limitations," no one persisting entity is referred to by the personal pronouns. One's leg is sometimes part of the self, but so also are one's clothes, one's family. Again, the leg is only a possession, not me but mine. It is an intrinsic part of the "I" that falls downstairs, but scarcely of the "I" that is democratic. The self is thus not an entity. But a convenient distinction is drawn indicating a configuration of

events, cohering as a system, with reference to which other events vary. In any such situation, the cohering configuration is the self, the fluctuating and variable remainder, usually extensive, is the world.

EXPERIMENTS ON DECISION

A few further descriptions of the course of subjective events in situations of choice will serve to render more concrete the account we have here given. In the following case the subject was requested to choose which of two presented pictures he would prefer to hang in his room.[2]

> For a moment I felt no particular preference, but, as I studied them, I felt a tendency to reject the right-hand picture. Then there began to come up reasons for the left-hand picture as against the other. The idea came, "This is a real Dutch setting; the other is nondescript." The setting of the one was indescribably superior to the other. The one was bright and the other grey looking. The decision came with a rush and a marked degree of finality. "This is mine," I thought [voco-motor?], and ceased to regard the other completely; it was as if non-existent for me. The whole experience was accompanied by a minimum of strain and the whole process was even and gentle throughout. At the same time I felt quite certain of my decision which was final and complete.

In this case, definite features of the two alternatives as presented seemed to be determinative; they were not really balanced alternatives. In the following subjective elaboration adds the determining influences. We are not even told what the alternatives were, yet the process of choice is clearly shown.

> In the first alternative the term "low grade" brought back a visual picture of myself correcting papers, and not having time to prepare my teaching work effectively. This was accompanied by a very strong feeling of dislike. I seemed to anticipate the term "future promotion" in my thoughts, and it served as a very strong

[2] The following citations are from A. H. Martin, "An Experimental Study of the Factors and Types of Voluntary Choice," *Archives of Psychology,* No. 51 (1922).

reason for disliking this idea. With the second alternative came a more pleasant feeling; I had the thought [voco-motor?], "Well, I will just have to be careful with certain comforts," and a vague image of a schematic table as representing the word "food" which came in verbal motor terms, cropped up. This image came up clear for a moment and then faded, and I knew that this was what I was going to do—to economize in food. The idea of the second alternative persisted, as it were, under the surface, as if part of me. After the decision I felt very relieved and pleased with my choice, which seemed a very good one.

Here it is the array of symbolized consequents and implications in connection with each alternative that finally gives one dominance, by the stronger feeling tone of agreeableness which it arouses. The actual decision is in part a motor affair (the verbal-motor declaration of a feature of the alternative), in part the vividness and persistence of a symbol (the visual image of a table), and in part the relief which these occasioned. When we say that these *are* the decision, we mean merely that they are the signs, indications, or evidences that the deliberation is now over; the field of attention has become stably organized.

In the final case, somewhat more elaborately described, the subject is to suppose that he is unprepared for a change in the weather, which suddenly turns cold and rainy. "Your way of getting home is by riding on top of a 'bus,' and thus risking pneumonia, or in an overcrowded subway train with an influenza epidemic at its height; which would you take?"

First came a faint visual picture of a bus pointed towards me, with the awareness that it meant coming "up town" as opposed to "down town." This was followed by a vague outline of the top of a bus and the bodily presence of myself in the back right-hand corner. The most conspicuous parts of this image were my shoulders and especially my chest.

That disappeared and the second alternative took form as a small area of a subway crowd, not larger than I could reach out and touch with my hand. I was the center of this area. There was a definite kinesthetic suggestion of restiveness, and a visual element with vague patches, meaning "people in close contact." This was associated with general bodily discomfort and a feeling of closeness, with a shrinking from them.

The word "influenza" was followed by a third image, with the consciousness that this was related to the second rather than to the first. Human faces appeared wearing handkerchiefs or influenza masks; there was a definite kinesthetic sense of direction to the north, meaning P——. Then in a curious way I reviewed the whole episode of the influenza epidemic at P——, and the wearing of the masks, but present with this was a definite feeling of calm and security. This was in contrast with the emotional tone of the first image (chest and shoulders prominent), which was accompanied by mild fear and avoidance.

I then reverted to the words on the page. Having been present, the images passed out, and I fixated the phrase "risking pneumonia," which was accompanied by the same mild emotion of fear. Then I reverted to the images of the white masks, and this constituted the decision. The feeling of the act of coming back to it was decisive.

Underneath all this was something not represented in imagery. Verbally it would have been, "You once had pneumonia and it might be dangerous for you, whereas you went through the 'flu' epidemic without harm." With this was an attitude verbally expressable as, "I must take this reference to my past experience as crucial and determining the present decision." I cannot say how articulate this was, but it was decidedly present.

Examining many such reports under varying situations and with different subjects, Martin finds it possible to differentiate the "preference," the "conflict," and the "indifference" types of decision experience. The first type is the one most often seen. It "proceeds smoothly, implies a rich subjective experience and is finally accompanied by a large measure of the self-assertive tendency." The second is "vacillating in its character, also implies a rich fund of associations, but appears somewhat lacking in regard to the degree of self-assertion that is present." The indifference type "is wanting in associative material, its process is apathetic, and it ranks lowest in the strength of the final self-assertive tendency."

QUANTITATIVE STUDIES OF CHOICE

Reaction-time experiments played a large rôle in the early history of experimental psychology. These were measurements of the time required, in human activity, for a cue to

instigate its predetermined consequent. Thus, through previous learning and present verbal instruction, a subject may be set to lift a finger from a telegraph key the moment a sound appears or ceases. By proper instrumentation the time may be measured which intervenes between the objectively recorded change and the instant of the motor reaction. Such reaction times vary with a great number of factors, relating to the "stimulus," the subject, and the experimental conditions.

In this manner artificial situations may be established which resemble those in daily life in which selection, discrimination, and choice are involved. Thus definite alternatives may be prearranged. The subject may be instructed to react with the right hand if red appears, with the left if green comes instead. Or he may be asked to report whether a given line is longer or shorter than another, the two being presented simultaneously or in succession. Reaction times thus measure the "difficulty" of the decision, the ease with which a specified cue evokes its predetermined response or consequent.

The literature of reaction-time experiments is enormous. Every conceivable factor has been studied, in its influence upon the temporal relations of such a sequence. We may here note only two particular results, for their value in showing the way in which the phenomenon of choice is actually a matter of discrimination, that is, selection of cues, and their relative potency.

When other factors are constant, the speed of reaction varies with the number of alternatives, if these are mutually exclusive or incompatible. Thus in one series of experiments numbers from 1 to 5 were assigned to the fingers of the two hands, one hand in Roman, the other in Arabic numerals. The task was to move the finger indicated by a number flashed in the exposure apparatus, this movement to be made as quickly as possible after the appearance of the number. Sometimes there were no alternatives, this being a simple reaction. Otherwise varying numbers of alternatives or possibilities were used, the number of alternatives, at a given setting, being known by the subject.

The reaction times increased definitely with the number of alternatives. The unit being one-thousandth of a second, the average times were as follows: Simple reaction, 188; 2 alternatives, 276; 4 alternatives, 394; 6 alternatives, 489; 8 alternatives, 562; 10 alternatives, 588. We may suppose that this reflects a general tendency. The resolution of alternatives involved in choice becomes slower and more difficult, the greater the number of rival possibilities.

It is also a matter of common observation that some alternatives may be more easily discriminable than others. In fact, we have shown that choice depends upon the development of an effective difference. It is possible to measure the time relations involved in such discriminations, at least on a relatively simple level, and to use these times as measures of the magnitude of the differences presented.

Thus one investigator presented pairs of lines, differing by various amounts in length as objectively measured. The subject was instructed to react with right or left hand, thus indicating the position of the longer of the two lines. The standard line was 100 millimeters long, the others being longer by 0.5, 1.0, 1.5, 2.0, 2.5, or 3.0 millimeters respectively, in terms of standard scales of visual length.

The following table shows typical results, these being from a single subject. In separate columns are given the comparison lengths, the differences between them in millimeters, the time of reaction (average) in each case.

TABLE XVIII

Discrimination Reaction Times

Comparison Lines, Length in Millimeters	Objective Difference, in Millimeters	Reaction Times, in Seconds
10 and 13.0	3.0	.295
10 and 12.5	2.5	.298
10 and 12.0	2.0	.304
10 and 11.5	1.5	.312
10 and 11.0	1.5	.323
10 and 10.5	0.5	.344

The investigator [8] concludes that "the experiments on linear magnitudes with equal objective differences in stimuli show that as the difference between the pairs of stimuli decrease in an arithmetic progression the differences in the time of perception increase approximately in a geometrical progression, for the magnitudes investigated." He makes, also, a further interesting comparison of differences in different fields, as indicated by the variations they produce in reaction time. "A comparison of differences in various sense departments, which this method makes possible in a definite manner, shows that in a general way a difference of 4 vibrations in pitch is relatively as great as a difference of ½ millimeter in lines, or again that a difference of 1 vibration in pitch is approximately equivalent to 2 wave-lengths in color in the red end of the spectrum." It is thus at least theoretically possible not only to note introspectively the differences in cue potency, but to state them in quantitative terms.

THE NATURE OF WILL

According to the account we have given, what may be called *will* is a complex resultant of native and acquired, organic and environmental developments and influences. If the native inclinations, the instinctive propensities, the immediate stimuli of the moment, and the mechanical intensities of current stimuli have their way, will is weak. If, on the other hand, the acquired tendencies, the learned symbols, the socially approved values, the remote ends, and the subtle inner cues dominate, will is then strong. "One may be said to have a strong will," writes Pillsbury, "in whom the influence of remote social influences is strong and the influence of temporary mood and hereditary impulse is relatively weak or well subordinated; while a man is of weak will in popular estimation if he is not capable of retaining permanently or even for long periods the influence of general social standards."

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[8] V. A. C. Henmon, "The Time of Perception as a Measure of Differences in Sensations," Columbia University Contributions, Vol. XIV, No. 4.

Will is then not a faculty but a fact; not a causal agent but the description of a particular picture or outcome. Roughly speaking, the alternatives in a situation involving choice may be two reflexes or instinctive (native) tendencies; or they may be two habits or acquired tendencies; or one may be a native and the other an acquired tendency. In a general way, "will" may be applied to the last of these situations, when the habit wins out. This is particularly the case if the habit is one which has high social sanction. Will is, therefore, not a psychological process but a popular category.

CHAPTER XXIII

THE PSYCHOLOGICAL RÔLE OF THE SENSES

THE SENSORY QUALITIES

If we start with any roughly discerned natural object, such as a rainbow or a piece of leather, we find that it is actually complex, can be described as constituted by or including varied simpler features. These features may themselves be independently identified, named, and considered objects. Thus the leather has its shape, its varying locations with reference to other things, its spread or extension, its color, odor, taste, and tactual feel. The total elimination of these "aspects," from both individual and social reports, means the disappearance of the object. The object *is* the socially described configuration and correlations of that array of attributes, qualities, relations, and coördinations.

As we have seen, since the relations and coördinations, (such as the spatial, numerical, and temporal features) are consistently reported, psychology has tended to ignore them. The attributes and qualities, being variably, inconsistently, and intermittently reported, have been considered mental and fit subject matter for psychology. Qualities are the sensory features, such as color, odor, taste, and the like. Attributes are the intensity, duration, clearness, and so on which characterize these qualities.

This procedure has led to many puzzling problems and to various arbitrary solutions. Thus a point of view which we may call "subjectivism" regards these qualities as a special kind of "stuff," comprising "mind" or "consciousness." This "corresponds to" or is "an aspect of" the play of "physical stimuli" and "nervous processes," conceived either as their "productive causes" or as their "conditions." Physical stimuli

and nervous activities are on this basis "non-experiential," since otherwise they would be analyzable simply into other qualities and attributes. The "structuralist" or "subjectivist" takes these as though given by some "intuition." At least, he gives no adequate intimation of the nature of our sources of information concerning them. Now the obvious fact is that what we call "the body" and what we call "stimuli" are also configurations of "experience," or else the attributes and qualities simply stand on a par with them as equally natural events, among which varied correlations exist.

On the other hand, certain half-hearted "realists" place the sensory qualities in the "physical world." Thus Bertrand Russell writes: "Accordingly the sensation that we have when we see a patch of color simply *is* that patch of color, an actual constituent of the physical world, and part of what physics is concerned with."[1] But, having thus attempted to draw a distinction, this author is subsequently compelled, by its consequences, to withdraw it. Thus he later is led to "admit" that "the patch of color may be both physical and psychical. . . . Sensations are what is common to the mental and physical worlds; they may be defined as the intersection of mind and matter."

The fact is that if we accept the parallelist view, as expressed by Titchener, for example, we are landed in intuitional mysticism. Thus he writes, "The two sets of events, physical and mental, are parallel, but they do not interfere with each other." But if we accept the view of certain "realists," who place sensation in the physical world and images in the mind, we must at once obliterate the distinction we have drawn. Russell, for example, is compelled to admit that "images and sensations cannot always be distinguished by their intrinsic nature," but only, if at all, "by their causes, as well as, in a lesser degree, by their effects."[2] The fact is that attributes and qualities, as well as relations and structures, are found at regions throughout the continuum of nature.

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[1] Bertrand Russell, *The Analysis of Mind* (copyright, Macmillan Company, 1921; reprinted by permission), p. 142.

[2] *Ibid.*, pp. 152-154.

Qualities from the "lower senses" (as pain, kinæsthesis) are highly subjective; those from the "higher senses" (as brightness and noise) are reported with great consistency; many other qualities (as taste, temperature) are intermediate or equivocal.

Psychological concern with sensory qualities does not consist in their description as "elements of mind." Nor does it consist in the physiological and anatomical or physical determination of the conditions of their occurrence and variety. A border-line science, which might be called "the physiology of the senses," is, to be sure, especially concerned with the study of the conditions and intercorrelation of such facts, as reported either by the individual or by the social consensus. And this field has been so extensively and intensively cultivated that it constitutes in itself a very considerable body of knowledge. But we do not consider that this body of knowledge has any immediate place in a survey of psychology.

Instead, we shall consider the various sense fields as they play a rôle in redintegrative sequences, or mental processes. They may do this in two ways. On the one hand, they may serve as the cues of activities for the individual in whose field of report they occur. Thus we have seen the great rôle played by kinæsthetic qualities and imaged qualities in the case of individual memory, reflection, and deliberation. Or they may function socially, as the signs of larger contexts, in the intercommunication between different reporters. In the field of language and in that of æsthetic products, art forms, this rôle is conspicuous. We choose to pay special attention in this chapter to the æsthetic possibilities of the various sensory modes, as a means of surveying some of the more definitely psychological facts of sensation.

THE HIGHER AND LOWER SENSES

When asked to state which are the higher and which the lower senses, most people feel no hesitation; they promptly arrange the various modes of sensation in an order of merit on this basis. Their various arrangements, moreover, show fairly close agreement, except perhaps in the middle of the

scale. Vision commonly stands at the top, followed by hearing. Touch and smell are given third and fourth places about equally often. Taste is likely to be next, and finally come temperature, kinæsthesis, and the vague organic qualities.

When asked what meaning they give to the term "higher," there is more disagreement. One asserts that he means by "higher," more elaborate, complicated, highly differentiated. Another means more useful, indispensable, of higher value. Others mean neither one nor the other of these notions, in any clear way. They have in mind some characteristic not immediately related either to structural complexity nor to practical utility. Neither do they refer to genetic antiquity. They use a criterion which can only be described as ethical or æsthetic, affective.

The distinction is an ancient one. Thus, to go back no more than three centuries, Burton, in *The Anatomy of Melancholy*, observes that "of these five senses sight is held to be the most precious and best. . . . Hearing is a most excellent outward sense. . . . Taste is a necessary sense. . . . Touch, the last and most ignoble of the senses."

Contemporary phraseology and convention are equally eloquent in the matter. There is common agreement that some of the senses, in their exercise or consequence, are ennobling, dignified, pure, and worthy; others are degrading, debasing, vile, and iniquitous. He who revels in sights and sounds, indulging the raptures afforded by tones, melodies, concords, colors, and their harmonies, the elements of visual form, design, and arrangement, is called "sensitive," "temperamental," "artistic." But he who revels in the unholy qualities of contact, temperature, smell, and taste is "sensuous" rather than "sensitive," "gluttonous" rather than "temperamental," and "vicious" rather than "artistic." The former pleasures minister to a "divine fire"; the latter only to "lust" and "appetite."

We distinctively esteem the workman whose craft consists in the preparation and arrangement of sights and sounds in pleasing order and composition. He "acquires merit," however unsuccessful; he is an "artist," and receives warm social

approbation. But only in the comic supplements is he an "artist" whose craft labors with the preparation and presentation of agreeable tastes, smells, touches, and temperatures. He receives no enviable social recognition; he is "cook" or "chef," chemist or dietitian. Painting is held to be an art; cooking is a service. The one is rewarded by distinction and eminence, the other, if at all, by wages.

In the field of art the distinction between the "higher" and "lower" senses is no less clear. Museums and galleries we have in abundance, in which are preserved and displayed the treasures of light and shade, color and form, line and arrangement. Private and public funds are appropriated that these patterns may have the widest possible circulation. Visitors and classes throng the corridors of these storehouses; teachers and schools flourish on the profits derived from communicating the principles derived in their manufacture. Statues are erected to the most deserving craftsmen, and earnest apprentices starve in foreign garrets that their handicraft may in time adorn these walls.

In the case of tonal qualities, the situation is much the same. All possible pains are taken to record the scheme and plan of their production. The heartiest welcome is accorded any device, instrument, or organization that facilitates their being stored up and poured out again for the delectation of remote or future audiences.

But to what museum or gallery shall one go who longs to experience the glorious array of pleasing contacts, textures, pressures, odors, tastes, and temperatures? Where shall one find stored up representatives of the most satisfying and thrilling touch impressions that experience has ever yielded? Where can one encounter the gamut of delectable odors, with the offensive ones deleted; where all the aromas, flavors, and savors in which the gustatory and olfactory worlds are so rich? And all the organic thrills, the kinæsthetic whirls and starts, and the delicious dizzinesses of static experience? Coney Island and its brood are the only institutions that even pretend to minister to those whose nature yearns for these satisfactions. It is supported neither by philanthropic

endowment nor by public appropriations. It is even said that its joys are thought to be "vulgar" among certain classes of peoples, whose passions run mainly toward sights and sounds.

Certain of the senses are undoubtedly more æsthetic than others, if by this we mean that special arts have been built up which busy themselves with the materials they afford, with their characteristic qualities. Other senses are unæsthetic, in the sense that the qualities afforded by them do not yield to that sort of manipulation which constitutes the procedure of the "fine arts."

BOUNTY OF NATURE AND ECCLESIASTIC CENSORSHIP

One may well inquire into such a state of affairs. Does it merely signify that agreeable sights and sounds are so rare in nature that special encouragement is given for their production? Are pleasing contacts, pressures, tastes, and smells so abundantly provided in the natural course of life that no such sanction is called for? Even if this were true, it is not clear why the sanction of the one group need necessarily involve the taboo of the other.

Does it perhaps merely indicate that early in the history of art the Church and its leaders learned that the original tendency of men and women to indulge in the voluptuous qualities of certain of the senses was so strong that the immediate joys of earth promised to outweigh the promised blessings of heaven? Such a discovery might conceivably result in authoritative denunciation of these qualities and in artificial exaltation of the tamer and milder senses of sight and sound. The objects of these senses could be perceived at a remote distance and by many observers and could, therefore, be more minutely scrutinized by the ecclesiastic censors.

Or does it perhaps mean that some sense qualities or "impressions," by their very nature, are unsuitable as materials for that sort of manipulation and craftsmanship which we call artistic? Or that, from their nature and consequences, they are inimical to those endeavors which we have come, on other grounds, to conceive to be the most worthy and valuable tendencies of humanity? The bounty of nature and the

ecclesiastic censorship we may dismiss from present consideration, however worthy they may be of reflection. We may confine our present inquiry to the question whether or not the impressions afforded by some of the senses are by nature inadequate as raw materials of æsthetic manipulation and artistic creation.

RANGE, DISCRIMINATION, AND REACTION TIME

We may begin the inquiry with consideration of certain technical characteristics of the different sensory modes, which can be measured or otherwise expressed in quantitative terms. Then we may observe whether the order, on these bases, shows any correspondence to that in the scale of æsthetic value. The following table brings together the facts concerning several such characteristics. In the first column the "senses" are arranged in the commonly accepted order of æsthetic value. Under "organic" are grouped various qualities which may equally well be regarded as different senses.

TABLE XIX

CHARACTERISTICS OF THE SENSES

Order of Æsthetic Value	Number of Discriminable Qualities	Sharpness of Discrimination	Average Speed of Reaction
Vision	About 40,000	Difference of 1%	About .189 sec.
Hearing	About 15,000	Difference of 33%	About .146 sec.
Smell	Nine classes, each with hundreds of qualities	Difference of 25%	Very long and difficult to determine
Touch	Three or four classes, with qualities not easily determined	Difference of 33% Less for pressure	About .149 sec.
Taste	Four classes, with number of qualities not determined	Doubtful	.300 to 1.000 sec.
Kinæsthesis ...	Four or five classes, number of qualities uncertain	Difference of about 5%	Difficult to determine
Temperature ..	Two classes, degrees not determined	Variable and uncertain	.150 to .180 sec.
Organic	About six classes	Unknown	Unknown

It requires only a glance at this table to show that we possess much more definite knowledge about sight and hearing than about the other quality modes. In the case of these two, the characteristics indicated in the table can be stated with considerable precision and certainty. But in the case of the remaining modes, only broad and vague statements can, for the most part, be made. Even the number of discriminable degrees or qualities which these modes afford is unknown, and statements concerning the other features are mainly confessions of difficulty or ignorance.

It is not easy to judge to what degree this is due simply to the greater attention that has been given to vision and hearing, and to what degree it is due to difficulties inherent in the qualities themselves, or the conditions of their appearance and recognition. It is, at any rate, apparent that no one of the special characteristics indicated in the table can be held responsible for the sharp cleavage commonly made between the worthy and the ignoble senses. We must look elsewhere for the reasons why the lower senses are unæsthetic, and lower.

With respect to number and range of discriminable qualities, sight and hearing, with their many thousands of distinguishable degrees and variants, might seem to afford such an abundance of material that this alone would explain why the principal fine arts are based on them. But it must be pointed out that this enumeration of qualities has reference only to the definitely identifiable, classifiable, and controllable variations. The mere fact that odors can be classified under nine or less headings is far from meaning that there are but nine discriminable smells. Almost every different object in the world has a characteristic odor as part of it or correlated with it. We have not developed abstract names for these odors, but are usually content to designate the smell by the name of the object with which it is associated. When one bears in mind their multitudinous variations, intensities, mixtures, and modifications, one is inclined to believe that it is only the infinite variety of smell qualities that prevents our enumerating, classifying, and naming them.

What has just been said of smell is no less true of touch, taste, and organic qualities. It is also true that the lower sense qualities seldom appear independently. Thus taste qualities are usually accompanied by smell, touch, temperature, and kinæsthesis. May it perhaps be true that the very fact that these impressions cannot be estimated, isolated, and reproduced at will has something to do with their inferior æsthetic value? However this may be, it is clear that the mere variety of impressions afforded is not the criterion of which we are in search.

Is the sharpness of discrimination, the keenness with which differences in the strength and intensity of the qualities can be reported, a factor in determining their availability for æsthetic manipulation? The figures given in the table under this heading indicate the proportion that must be added to a stimulus (objectively measured) in order to make it perceptibly more intense (as directly known). Sight is the most delicate of the senses in this respect, as it is, also, in number of identifiable qualities. But kinæsthesis follows close upon it, smell stands third in the list, and hearing is no more sensitive than pressure. In the other cases, the values are unknown or difficult to determine, but it is clear that æsthetic order does not depend merely on these psychophysical constants.

The quickness with which a reporter can react to or perceive impressions in the different sense modes discloses much the same situation. Basing our comparisons on average reaction times to the most commonly available and convenient intensities in each case, hearing, touch, and temperature are seen to be about equally prompt in this regard, while vision stands fourth on the list.

A sense quality or impression once aroused, has also a characteristic "life span," unless renewed by its correlated conditions. Only three of the values, for sight, hearing, and touch, have been determined. These bear no significant relation to one another, but all are short and the modes stand high in the æsthetic scale. The other values, though not determined, are known to be longer. May it be that the sluggishness of the lower senses and the persistence of impressions set up

therein prevent their qualities from submitting to the forms, patterns, and structures which constitute artistic treatment? Or is it not equally likely that the fugitive character of impressions from the higher senses is what has made necessary the development of treatment by means of pattern and structure?

THE LAW OF RELATIVITY, AND WEBER'S CONSTANTS

We may here digress for a moment to consider a topic to which traditional psychology has given much attention. This is the so-called "psychophysical law," based originally on the observations of Weber and Fechner. Generally speaking, it is a law of relativity. Equal increments of stimulus intensity (as mechanically registered) do not produce equally obvious increases in sensory intensity. The difference between 20 pounds and 21 pounds, for example, is usually appreciable by "hefting," that is, kinæsthetically. But if the standard be 60 pounds instead, the addition of 1 pound is seldom felt.

For the same degree of difference to be felt, 3 pounds must be added to the 60. In each case, the difference is 1/20 of the standard. Of course there is no sharp "threshold" of difference, no definite line between same and different, in such comparisons. *Any* difference will be reported, with a frequency varying with its magnitude. But if we specify a certain correctness, say 75 per cent of the time, as indicating a "sensed difference," then the difference of 20 and 21 pounds is sensibly equal to that of 60 and 63 pounds. The two differences are equally often reported correctly. With small weights, 1 pound makes a difference; with larger weights the *same difference* requires a larger stimulus.

This is a "law of relativity" in that, in a given sense field, at least in the middle of the range of intensities, it is not absolute but relative differences that determine report. Fechner maintained, further, that differences which are *equally obvious* are, therefore, *obviously equal.* It is, however, difficult to show that they are equal in any other sense than equally often reported, equally noticeable. The law of relativity is

sometimes given a mysterious tone, with the intimation that "physical energy," in being *transformed* into "psychic energy," is strongly handicapped by the law of "diminishing returns." We may briefly consider what is involved in this relation between supposed physical and psychic energies.

Objective measurement means measurement by a "machine" which is so constructed, if possible, as to "capture" all of the effect of a cause or stimulus. Thus a thermometer wastes none of the heat stimulus applied to it. The mercury merely expands; it does not dance, nor sing, nor feel alarmed. But in other cases so much of the effect of a cause is distributed (dissipated) that, from the point of view of a particular result, much is wasted. Thus the burning of coal under the boiler of a steamboat not only moves the propeller; it also shakes and heats the engine, and causes general vibration of the vessel. No energy is *lost* in the total effect, but much of it never reaches the propeller. The engineer, with his mind intent on speed, is handicapped by "diminishing returns."

Something analogous to this seems to be involved in Weber's law. A wave motion may be mechanically registered with no loss of intensity. But applied to the ear of a man, this stimulus does more than cause an "auditory quality." The man also jumps, tenses his body, moves his eyes, catches his breath; his heart beat and blood pressure change. If we suppose that such "energy" radiates through the system, we might also expect that the dissipation or waste, from the point of view of sound production, would be relatively greater, with greater magnitudes. The area of a circle of radiation varies as the square of its radius; the circumference is a constant multiple of its diameter. A stimulus radiating from a point might thus be dissipated or wasted in greater proportion, the greater its range of distribution. From a fixed point in the system, this might give a law of diminishing returns. This, of course, is a mere analogy, but something like this situation seems indicated.

That different proportions must be added to produce equally discriminable differences in the various sense fields, we have just shown. The discriminable change in vision and in kin-

æsthesis is slight (1 per cent and 5 per cent), suggesting perhaps relatively little "waste." For hearing, smell, and certain aspects of touch the required changes are gross (25 per cent to 33 per cent), suggesting wide dissipation in the "effect." The law of relativity in the case of sense differences thus results, we have suggested, from noting only part of the effect or consequent (the sensory quality) and describing this as the total effect of a stimulus. It points to no mysterious relation between two realms of energy. A very similar law of relativity characterizes also our appreciation of various magnitudes other than sensory intensity. Such a law is present in the response to spatial and temporal magnitudes, to fines, losses, taxes, and in the excessive evaluation of slight degrees of virtuosity we seem to make deliberate allowance for it.

THE TENDENCY TO ADAPTATION

Suggested by the question concerning "life span" is another characteristic of sensory quality which one might expect to be important. This is the phenomenon of adaptation. In the case of odors, temperatures, and contacts we easily and speedily become adapted to the continuous presence of impressions, and their qualities may fade. With prolonged observation and persistent fixation, colors tend toward gray, pressures tend to disappear, temperatures tend toward a neutral point, and sounds become indifferent. Thus we soon become adapted to the presence of hats on our heads, the clothes on our backs, the smell of smoke, and even to such extreme temperatures as that of the stoking room. In some cases this appears to be a phenomenon of attention. In other instances it is attributed to some correlated adjustment in the sense organs or in the nervous centers whose activity is correlated with the quality. Continuous stimulation is said to "raise the threshold" so that the original conditions are no longer effective.[3]

The laws and effects of adaptation are by no means the

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[3] Recall, however, the account of adaptation given in Chapter V.

same for all the senses. Thus the tendency is less conspicuous in sight than in smell, although this may be due to the restlessness of the organ of vision, so that the persisting quality, as red, is correlated with *different* structures, from moment to moment. But the tendency is as prominent, although perhaps on different grounds, in hearing as in many of the lower senses. Moreover, this tendency to adaptation refers to the continued presence of the same degree or quality. But in æsthetic manipulation the qualities presented are varied from moment to moment and from point to point. Hence there seems to be no relation between æsthetic order and tendency to adaptation.

THE SPATIAL ATTRIBUTES

It has been suggested that the absence of definite and formal spatial attributes and systems is what makes certain of the sense modes unsuitable for æsthetic treatment. There are two important objections. One is found in the earlier query as to the reasons why æsthetic treatment should necessarily consist of arrangement in spatial and temporal series and patterns. Unless some good reason to the contrary is given, we are free to assume that this is not a necessity but an incidental result. It might result from the intrinsic character of the materials which on other grounds, for which we now seek, are chosen as the raw substance for æsthetic treatment.

The other objection, which is perhaps more convincing, is the fact that, whereas touch and kinæsthesis both possess immediate voluminousness and readily take their place in a spatial manifold of position, direction, form, and distance, they do not yield to æsthetic treatment. While sound and taste, one of which easily ranks second while the other belongs low down in the æsthetic order, possess extent in only a very doubtful and probably analogical manner. And they are almost if not wholly lacking in those attributes which would enable them to participate in a manifold of position, direction, form, and distance.

As for temporal attributes, such as duration and sequence, all qualities possess them. The difficulty of giving spatial or temporal pattern to the lower sense qualities is an inadequate explanation of their inferior status as a technique of representation or communication. But it is perhaps important that of the two higher senses, one is especially marked by spatial and the other by temporal attributes. And it is significant that of the two chief modes of verbal communication, one, that of speech, is based chiefly on temporal and qualitative patterns. The other, that of writing, is based chiefly on spatial and qualitative patterns. And kinæsthesis is involved in both writing and talking. The meaningful signs of language lie for the most part in hearing and vision. We shall see at a later point that this relation between æsthetic value and mode of communication cannot be overlooked.

IMMEDIATE AFFECTIVE VALUE

Perhaps the greatest surprise comes when we consider the immediate affective value of qualities in the different modes—their feeling tone. Tastes, smells, and contacts are likely immediately to provoke definite and intense feelings—pleasantness, disagreeableness, excitement, calm, tension, and relief. Still more complex patterns, emotions, are called up easily by impressions in the lower senses. Immediate pleasure tone and associated emotions are often exceedingly rich and intense. The smell of new-mown hay, coffee, flowers, whiffs of the salt sea breeze, the odors of animals, foods, spices, and herbs, move us to strong emotion. The stroking of fur, the cool of evening, the languor of a sun bath—all these have high and immediate affective value scarcely exceeded by immediate feelings provoked by colors, forms, noises, or tones in the "higher" sense fields.

In general, those senses closely connected with bodily welfare provoke strong affective reactions and convey to us a strong sense of reality. Senses less intimately related to organic welfare possess weaker feeling tone of the intrinsic or native sort. Disagreeable odors, tastes, and contacts are

quite beyond our endurance, but few are the sights and sounds to which we cannot easily reconcile ourselves.

Here, then, we find an interesting and perhaps quite unexpected fact, that sense impressions possess æsthetic value just to the degree that they natively and intrinsically *fail* to arouse in us definite and powerful emotions. In just the degree to which sense qualities fail to produce immediate pleasure and aversion, fail to provoke instinctive emotions of joy and disgust, fail to stir in us moods of irritation and acquiescence —in just that degree do they declare themselves adequate raw materials for the fine arts. If, as we are often told, the primary purpose of art is to please, this is an entirely unexpected result. We shall return to it at a later point.

DEVELOPMENT IN RACE AND INDIVIDUAL

The æsthetic order of the senses is approximately that of their phylogenetic and ontogenetic development. The simplest and most undifferentiated forms of life show sensitivity to conditions which in us are correlated with the qualities of contact, movement, pressure, temperature, and pain. "Touch," as Aristotle observed, "is the mother of the senses." Starting from this mode of sensibility as a basis, the other senses develop as we ascend the animal series, by processes of increasing complexity and refinement.

Taste and smell were probably the next to differentiate from the vague mass of tactile and organic sensation, then hearing, and last of all sight. And there is evidence of sequence within the single sense fields. Thus it would appear that brightness vision, sensibility to mere light and shadow, antedated color vision by a considerable period. Sensibility to the various color impressions or qualities seems also to have developed in a serial order, blue and yellow being more primitive than red and green.

It is also true that the sense organs are at the birth of the individual in somewhat diverse conditions of functional perfection. The senses of taste, touch, temperature, and pain operate perfectly at birth. Hearing is defective for one or two

weeks, and the mechanism for vision is in some respects imperfect until the various coördinations of eye muscles are effected. The genetic order of development thus accords closely with the order for æsthetic value; the "higher" senses are the ones later acquired.

IMAGERY VALUES OF THE SENSES

A further characteristic which correlates closely with the æsthetic arrangement is the relative ease and vividness of imagery in the various sensory modes. These constitute in a sense the varying "imaginational" possibilities. With most people, as adults, visual and auditory imagery is more vivid and intense, more facile and prompt, than is imagery in the remaining modes. Dreams, which consist so largely of imagery (plus verbalization, kinæsthesis, organic sensation, and feeling) are commonly visual in character. Hearing is a close second, and the other modes are scarcely involved in the form of imagery. Both normal and insane hallucinations are more frequently visual and auditory, with hearing somewhat more prominent than sight. Perhaps the possibility of imaginal quality, contemplation in the presence of but part of the original stimulus, is a prime qualification of sensory impressions that are to serve as æsthetic materials.

SYSTEMATIC RELATIONS OF QUALITIES

In the case of some of the sensory modes, it is possible to arrange the various elementary qualities in a schema or diagram. Such a schema represents the mutual relations, either of the qualities, or of the conditions of their appearance, the results of their combination, their influence on each other, and so on.

Thus in the case of vision, the conventional "color pyramid" expresses the various relations between the elementary colors and the different degrees of brightness. Red, yellow, green, and blue occupy the corners of the base of a double pyramid. The upper apex represents white and the lower apex black, these being the extremes of the series of brightnesses or grays.

On the side between red and yellow are found the various oranges, which result from mixing the stimuli to red and yellow, in varying proportions. On the remaining sides are represented the combinations of yellow and green, green and blue, blue and red. Along the vertical axis range the different grays; and cross sections indicate, at different levels, the various tints and shades. Along the base, the colors at the extreme ends of any diagonal passing through the center are complementary. Their stimuli neutralize each other when mixed, and under other circumstances each tends to induce the other by contrast. The visual manifold may thus be adequately schematized on a three-dimensional figure, which indicates in part the observed relationships of the visual qualities, in part the relationships of their physiological correlates.

In a similar way the various tones, in the case of hearing, may be arranged along a one-dimensional line, which represents the tonal scale, but does not provide for the various noise qualities. Taste qualities have been laid out in various diagrams. One suggested scheme arranges them in a circular area, with bitter and sour, salt and sweet, as the poles of two chief diameters. Other tastes would then be represented by points on the circumference or along some diameter. But the schemata for taste and smell are of very doubtful validity.

Special studies of sensory qualities have dealt in great detail with such questions as the elementary qualities in each mode, the derivation of other qualities by the combination, fusion, and mixture of these elements, and their varied relations, as of compensation, antagonism, fusion, and contrast. We cannot here go into details of the physiological psychology of the special senses.

We may, however, consider some of the general results, with respect to their bearing on the question of the æsthetic order of the senses. It is especially in the "higher senses" that the various qualities exhibit the structural and systematic relationships which these diagrams portray. Definite and formulable relations with respect to such facts as fusion, harmony,

tonality, melody, saturation, contrast, mixture, complementariness, and so on, may be made out in the cases of vision and hearing. Æsthetic manipulation takes in part the form of playing upon these relationships, and their affective values. The visual and auditory qualities constitute not merely a manifold, in each case, but yield systematic structures. But the "lower senses" tend to constitute, in our present knowledge, mere unorganized manifolds.

It might be suggested that here we have the adequate criterion of the æsthetic for which we are in search. Perhaps this is the reason why visual and auditory experiences are the ones that are "described, discussed, repeated, measured, and creatively embodied in works of art." But such an explanation, however suggestive, is surely in part fallacious.

We do not know what structural systems would be exhibited in the lower senses if we had only discussed, measured, and embodied them to an equal degree. We do not know to what degree the appearance of superior organization on the part of the higher senses is due to the amount of effort and inquiry bestowed on their examination. What we know is that innumerable studies have been made of sight and sound, resulting in the various schemata and diagrams. Comparatively few studies of equally intensive and extensive type have been made of the lower sense fields. We are proportionately unable to construct the corresponding schemata and diagrams. Which is cause and which effect? Do the lower senses fail to provide raw materials of æsthetic construction because they lack elaborate and systematic organization? Or do they owe this very deficiency to the relative neglect they have suffered at the hands of the artist?

"SOCIABILITY" OF THE DIFFERENT SENSES

The higher senses are also the so-called "distance receptors." They do not require immediate contact with the "stimulus." But the lower senses inform us mainly concerning objects in direct or approximate contact with our own body. By virtue of this fact, it has often been remarked, it is possible for many

of us to see the same object, such as a rainbow, however far apart we may be from each other. We can all hear the same melody-producing instruments if we place ourselves within a certain fairly large area.

But social experience is scarcely possible in the case of contact, taste, smell, temperature, pain, kinæsthesis. Here the most we can do is to get the experiences in succession, and even this is often impossible. Even when we "take turns" we find it difficult to confer, since conference is now on the basis of memory. Even immediately recorded reports show great variability.

It is, moreover, true that in some of these cases the "stimulus" itself is "consumed" in the production of the quality. These are lower, unæsthetic senses. Not only is social experience impossible, but the individual himself cannot get the experience again. Can it be, perhaps, that as Thorndike suggests, "the pleasures of taste are not called æsthetic because one cannot eat his cake and have it, too"?

It begins now to appear that only those senses can become æsthetic vehicles which somehow lead beyond themselves, beyond the immediate gratification of the individual, and facilitate some sort of social participation, coöperation, or conference. We do not, of course, mean that the lower senses are unæsthetic because they minister mainly to our personal and immediate physiological needs. Nothing could be farther from the truth. It is not because taste, smell, touch, and kinæsthesis are mainly concerned in telling us of facts that are of vital importance to us as individuals that they are low or unæsthetic. It is only because they do nothing *more* than this, because they cannot become the vehicle of our individual and social conference and communication. An interesting statement on this point is given by Calkins, here quoted in full.

It thus appears that even perception, the consciousness, as we call it, of outer things, is a consciousness of other selves as sharing our experience, a relatively altruistic, not an exclusively egoistic mode of consciousness. This is the reason why we usually speak of sight and hearing and smell as higher senses—and in the order named—

than taste and the dermal sense experiences. Vision is the sense most readily shared by any number of selves: for example, everybody within a fairly wide area may see the mountain on the horizon or the Milky Way in the evening sky. Next to vision, sounds are the most frequently shared experiences; millions of people hear the same thunder and thousands may share the same concert. Even odors, though shared by fewer people, may be common to very many, whereas tastes and pressures and pains, which require actual bodily contact, and warmth and cold, whose physiological stimulation depends on conditions of the individual body, are far less invariably shared experiences.

But the shared experiences are those that are described, discussed, repeated, measured—in other words, those that are creatively re-embodied in works of art and in scientific investigations. Vision, therefore, is a higher sense than the others, only in so far as it is more often shared, and hence more often discussed and described, measured and verified. This is the reason why it is a more significant social material of intercourse, art, and science. Pressure and warmth, on the other hand, are less valued, because they are less often actually shared and, therefore, less easily verified and less frequently described.[4]

These are illuminating paragraphs, but they are satisfactory only when amplified in certain ways. Thus we have seen throughout this volume that the "sameness" of objects *consists in* the unanimity of their report, rather than being responsible for it. We call it the same concert, the same mountain, because individual reports are consistent, and the conditions or correlates of production are easy. We call the pains and organic feelings different, in actuality, only because the reports, under a given set of arranged conditions, are discrepant. It is, therefore, consistency of report rather than prior sameness of object that must be stressed.

Furthermore, it cannot be said that the socially shared impressions are chosen as the raw material of the fine arts merely because they enable a multiplication of individual pleasures. The dominant passion of the artist is not merely to afford pleasure to the greatest possible number of observers. But so long as art is defined as an attempt to please, this is

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[4] M. W. Calkins, *Introduction to Psychology* (copyright, Macmillan Company, 1921; reprinted by permission), Chap. on "Perception."

about all that follows from the social character of the higher senses. As a matter of fact, artists do not seek to please the greatest possible number of observers, although entertainers may. Artists are often contented if a single observer is satisfied, but by satisfied, in this connection, one means something more than pleased. We have already seen that the most pleasing of all sense impressions are those afforded by the lower senses. If the mere production of pleasure is the chief aim of the artist, he would surely have resorted to those materials which intrinsically facilitate his purpose. Cooks are able to please more people than are sculptors and poets.

THE MOTIVE OF ÆSTHETIC PRODUCTS

There is some further reason why the æsthetic sense qualities are those genetically most recent, in imagery most clear and enduring, pertaining mainly to the distance receptors, markedly susceptible of spatial or temporal pattern, capable of systematic and organized description, relatively free from immediate feeling tone, and informing us of objects on which consistency of report is great.

The reason seems to be that the main thing about an æsthetic presentation, arrangement, or composition is, after all, its symbolic content, its "meaning." The artist desires, above all, to eliminate our own immediate and native reactions to his materials; he does not aspire merely to decoration. In so far as he is an artist, he is not satisfied with the relatively easy accomplishment of presenting to us a pleasing array of sensory qualities and patterns.

His main concern is in communicating to his observers an intimation of some situation, some theme, some state of affairs, some purely relational fact, some *meaning*. Such emotions as are stirred in us he does not wish to come from his mere materials, but from his own manipulation of them, from the form and pattern which he gives them, from the past contexts which they, as trivial details, represent, from the meaning which he thereby conveys to us. This is by no means necessarily a "message," a moral lesson, any more than it is

a mode of decoration. Stout makes a similar comment, when he writes: [5]

> The distinction between what we call the higher and lower senses rests on this contrast between the intrinsic impressiveness of sensations and their value for perceptual consciousness. . . . The relatively higher senses deserve this title in proportion as they are more delicately discriminative and more capable of being combined in successive and simultaneous groups and series, while preserving their own distinctive differences. On the other hand, each several sensation is proportionately less important through its own intensity and pleasant or painful character. Any direct effect produced by its own intrinsic intensity and affective tone would interfere with its value as a vehicle of meaning—as an indication of something beyond its own existence. Thus, as perceptual consciousness becomes relatively more prominent and important, sensation is more delicately differentiated, more definitely restricted, less intense, and less strongly toned in the way of pleasure and pain.

The artist, therefore, works under the limitations of the redintegrative paradigm. It is significant symbol and form, not native feeling tone, for which he strives. We have shown throughout that "meaning" is not biological utility nor native potency. Instead, it is derived from past contexts in the life of an individual, for which present details may now function as surrogates or symbols. In communicating with others the artist, as distinguished from the decorator and entertainer, requires materials that are potent cues, not from the history of the species, but from the experience of the individual. They must, however, be chosen from the fields of common experience or consistent report. They must be manipulable and presentable to others; that is, their correlates and conditions must be in ready and facile control. The more relational the materials are, the easier the escape from native feeling tone and the freer the use as symbols for particular contexts.

Speaking largely, the artist is neither entertainer, athlete, nor technician of any sort, but a philosopher; and that is the reason why vision and hearing are "high" and why the other

[5] G. F. Stout, *Manual of Psychology* (Hinds, Noble and Eldredge, 1915), p. 224.

senses are unæsthetic. But the lower senses, as we have seen, afford rich materials for the individual symbolization of situations, relations, and alternatives. As instruments of individual reflection, organic and kinæsthetic qualities, for example, compensate for the merit which they forfeit in the play of social communication. In both cases, the merit is that of standing as the cues of meaningful contexts. Both art and thought rest upon the technique of redintegrative sequence.

CHAPTER XXIV

INTELLIGENCE, CHARACTER, AND TEMPERAMENT

PERSONAL TRAITS AS RESULTANTS

Biologically considered, the individual is an organization of systems or organs. In complex animals, special systems or organs come to be involved in particular vital functions or activities. These are chiefly metabolism, reproduction, sensitivity, conduction, and motility. These systems are so interrelated and so derived that a general "quality of the organism" is discernible. Some organisms are vitally superior, better adapted to the biological demands of life. In spite of many complications and special influences, the quality of the organism is likely to characterize all its related systems.

Psychologically, an individual is a system of activities. Mental adjustments are processes or sequences, following the redintegrative pattern. These are also systematized and interrelated, and this organization we call the individual's mind. We may analyze such processes into their components, thus identifying cue and consequent, past context and present instigation. According to the range or scope, subtlety or delicacy, promptness or permanence, of these processes, we may characterize the mind as well or poorly adapted to the psychological demands of life. In spite of many complications and special influences, we find something like a general quality characterizing all these features. There is a mental as well as a biological vitality, and these are themselves closely related.

From the practical point of view, the organism may be so constituted that we call it powerful, healthy, sturdy, frail, or sick. These terms are names of resultants. The body does not *contain* power or health, or frailty. These are not identifiable ingredients of its composition. They are consequences

of its general quality and particular make-up. So also mental processes result in practical consequences, products, or resultants. These we may characterize as intelligent or stupid, stable or unstable, strong or weak. But stupidity, instability, strength, are not ingredients of the mind. They are the names of resultants or consequences of its particular make-up and general quality.

In this respect, for example, health, beauty, and intelligence are terms of like sort. Health is not something found in the organism, nor something of which it has a given amount. It is, instead, something which it *manifests*, and to a certain degree. Nor is beauty a personal possession. It is, instead, a particular *effectiveness*, involving also the standards of the spectator. Nor is stupidity a describable mental event. It is a degree of incompetence which results from the way in which mental activities go on.

Various misconceptions might be avoided if we should use the term *intelligence* for low degrees of *stupidity*. For common speech erroneously suggests that intelligence is "some thing" of which an individual has a given amount. Stupidity is then defined as a small amount of this thing. But it would be equally incorrect to describe stupidity as some entity, which intelligent folk have only a little of. Strictly speaking, only the adjectives should be used, stupid and intelligent. There would then be a felt demand for a descriptive account of the factors justifying these adjectives.

THE NATURE OF INTELLIGENCE

To what activities shall we apply the word "intelligent?" Comparative and social psychologists have suggested such criteria as delayed or disproportionate response, variability and unpredictability of conduct, modifiability and retention through experience, unity and coördination, pursuit of remote ends, reaction to adjustments of others, control by ideas. These are suggestive hints, but they are neither singly nor in combination adequate to identify the intelligent act. Exaggeration of any of these, as well as lack of them, marks the

individual as unintelligent, ineffective, or stupid. Only some golden mean, some reasonable degree, of these characteristics marks the intelligent act or animal.

Binet suggested three characteristics of the thought process, which are often offered as definitive of intelligence. These are "tendency to take and maintain a given direction," "adaptation for the purpose of attaining the desired end," and "self-criticism." These suggestions, useful in practice, nevertheless illustrate the essential difference between a criterion and a description. We may, for example, describe *water* also by indicating three features which characterize it. These are (*a*) its tendency to run down hill, (*b*) its capacity to extinguish fire, and (*c*) its usefulness in satisfying thirst. However practically useful these features might be as criteria of the presence of water, they scarcely constitute an adequate description of it.

Various other definitions of the intelligent act or of intelligence have been proposed. We may cite a few, briefly, for the sake of a subsequent synthesis. Ebbinghaus declared that "intellectual ability consists in the elaboration of a whole into its worth and meaning by means of many-sided combination, correction and completion of numerous kindred associations." Meumann defines intelligence as "the power of independent and creative elaboration of new products out of the material given by memory and the senses." Stern's definition is, "The general capacity of an individual consciously to adjust his thinking to new requirements."

The chief features emphasized in such definitions are (*a*) the influence of the past, (*b*) adaptation to the new, and (*c*) the operation of wholes when only parts are given. To these we may add (*d*) sagacity, if we consider also James's definition of "reasoning" as an equivalent attempt. This art he defined as consisting of "two stages: First, *sagacity*, or the ability to discover what part lies embedded" in the present situation. "Second, *learning*, or the ability to recall promptly [this part's] consequences, concomitants, or implications."

We may, following James, reduce all these to two factors or features. These are (*a*) The effectiveness of present details

as substitutes for past contexts, in the instigation of consequents. This is learning. And (*b*) Openness or large scope for the present situation, so that all the significant details may jointly influence the consequent. This is sagacity.

Intelligence is thus not a mental energy, psychic force, power, or instrument, substance, or entity. Intelligent acts are those in which present symbols effectively operate, under the influence of a symbolic present context, in terms of historic wholes. Degree of intelligence depends on two factors. The first is the subtlety of the partial cues which function for past contexts, and their speed and precision of operation. This we have described as the essence of *learning*. The second is the synergy, integration, or joint contribution of available cues from the present, and the range or scope of them which may thus jointly coöperate. This we have described, in the chapter on attention, as *sagacity*.

The dog who flees when the passer-by stoops as if to pick up an object, reacts to a sign, has learned, and this is an intelligent act. But it would be *more* intelligent, if the dog, instead of reacting solely to this single detail (in the light of its past contexts) should note also that the object reached for was only a feather, and allow this also to determine his reaction. The dog has learned; the symbolic gesture is effective or meaningful. But he lacks sagacity; he is oblivious to other concurrent details, for him not significant.

The neurotic soldier reacts to signs—sights, sounds, jars—in terms of past contexts. This is a result of effective learning, a case of meaning. But the particular details are so prepotent that other features of the situation in which they occur remain obscure and impotent. They do not jointly contribute toward the resultant. Intelligence requires both learning and sagacity. Hence neurotics have intelligence defect. They may lack either docility (capacity for learning) or sagacity. The neurotic individual is a prey to past situations and cannot find his way effectively among present contexts. But the feebleminded, however open to stimuli, fail to use them as symbols through ineptitude for learning. Inadequate intelligence may result from either or both modes of inferiority. It involves

both "number of connections" and scope or integration of stimuli.

SYNTHESIS OF DEFINITIONS

If we now refer again to the traditional definitions of intelligence, we find them to be directed to one or another aspect of this descriptive picture. They must be combined in order to constitute an adequate definition.

Those who emphasize the rôle of learning and experience are overimpressed by the fact that it is the *past context* that determines the instigative efficacy of the present cue to action. And it is true that acts could not be intelligent except for this contribution of experience. But they may be stupid, in spite of it.

Those who emphasize completion and elaboration are struck by two facts. One is the partiality or incompleteness of the cue, as compared with the total context which it represents. The other is the scope or synergy, which permits the joint influence, the com-prehension, of many details, to constitute a single pattern.

Those who stress the rôle of adaptation to new situations are absorbed in the very significant fact that, since or in so far as nature is uniform, future welfare depends on the success with which present signs stand for past situations, emergencies, and techniques.

LEARNING AND SAGACITY

An elaborate and recent empirical analysis of the nature of intelligence is that of Thorndike, who first seeks to explain differences in "intellect" by learning alone, by "number of bonds or connections." Thus he writes:

> In their deeper nature the higher forms of intellectual operation are identical with mere association or connection forming, depending upon the same sort of physiological connections but requiring *many more of them*. . . . The person whose intellect is greater or higher or better than that of another person differs from him in the last analysis in having . . . simply a larger number of connections of the ordinary sort.

> The gist of our doctrine is that, by original nature, the intellect capable of the highest reasoning and adaptability differs from the intellect of the imbecile only in the capacity for having more connections of the sort described.[1]

This is clearly an attempt to describe intelligence differences in terms solely of what we have called "instigative potency," native or acquired. What are here called facts of connection we have called facts of sequence. But we have found this fact of learning inadequate, and were compelled to recognize native differences in sagacity.

This author also, at the close of his chapter, recognizes the probable importance, among other things, of a factor similar to that which we have called sagacity, scope, or synthesis. Thus he writes:

> There is also perhaps a capacity for having the neurones act *with reference one to another,* that is, with *integration,* whose low or negative extreme is pronounced dissociation, as in hysteria, and whose high or positive extreme appears as a notable good sense or adequacy in the use of one's experiences. This capacity may be largely irrespective of [number of connections]. There is also perhaps a capacity for resisting intellectual panic and confusion. [These factors result in] dissociation [and] irrelevance.

It is just this synergic, joint determination by many present details to which we apply the single term "sagacity." It is some original factor in individual make-up which does not permit isolated tendencies to have undisputed right of way, but *com-prehends* different concurrent stimuli into a single present context. It is not presence of connections, but scope for stimuli, that characterizes it, and the sort of scope which permits the *integration* of stimuli. Thus the otherwise discrete influences are compelled or enabled to act "with reference one to another," and relevance is present as well as instigation.

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[1] E. L. Thorndike, *The Measurement of Intelligence* (Teachers' College, 1927), p. 415.

THE IMPORTANCE OF SYMBOLS

A popular distinction is often urged between abstract, social, and mechanical intelligence. This is only a dramatic statement of the fact that consequents (adjustments) may lie on the symbolic, the affective, or the postural level. A chair, as we have seen, may be defined, admired, or sat upon. A neighbor may be instructed, discouraged, or wrestled with.

But the notion that there are *kinds* of intelligence is misleading. It should be corrected by the simple statement that the response to a sign may be either another sign, or a feeling, or a movement. There is close correspondence between the effectiveness of redintegration on the three levels. But since incompetence is more striking the more complex and subtle the level, individuals relatively incapable of symbolizing activity (imagination, reasoning) may nevertheless, work effectively enough for rough practical purposes, with raw materials, tools, or domesticated animals. They could work still better, were they less stupid. But a degree of stupidity that is conspicuous in the writing of a sonnet may not obviously appear in the milking of a cow.

In recent years there has been a remarkable technical development of scales and tests for the expeditious identification of the intelligent. Acts that are *more* intelligent have been arranged in *hierarchies,* above those that are *less* intelligent. With such instruments it is found possible in a consistent, practical, and predictive way, to grade not only the intelligent character of acts, but the competence of individuals in their performance.

It is of great psychological interest that the tasks or acts found more suitable for use in such "intelligence scales" are chiefly operations involving such symbols as words, numbers, codes, diagrams, pictures. The best single brief test of intelligence is vocabulary and the use of words, in the case of individuals with equal opportunity to acquire these modes of symbolism.

Such materials are the elements of language. We have already seen that the understanding and use of language are

the most complete and preëminent example of mental process. In language, learning and sagacity intimately combine. The use and understanding of a linguistic system calls for two things. One is that the present detail shall function as a surrogate, sign, or symbol for *past* contexts. The other is that the *present* context (the theme, the accompanying words, etc.) shall also assist in determining for *which* past context the given sign now functions. This is the perfect picture of the intelligent act.

Thorndike, in the volume to which we have just referred, notes that:

> Our tests might draw upon anything for their material. They have in fact greatly favored words, numbers, space-forms, and pictures, neglecting three dimensional objects and situations containing other human beings. How far this has been due to convenience and how far intellect is really best measured by its operations with words, numbers, space-forms, and pictures, is a matter that obviously deserves investigation.[3]

In selecting materials for his own construction of a serviceable measure of intellect he was guided by a full sense of all the possible considerations. As a result he observes that "we have not included any tasks involving responses to actual human beings or to material objects present to sense. . . . Our tasks all concern responses to ideas and symbols, especially words and numbers."

We have shown throughout this book, and again emphasized in the present chapter, the considerations which must at least be the chief reasons for such a choice. This is that the essence of mental process consists in the operation of symbols. Symbolism of a sort is, of course, involved even in ordinary social, spatial, and other forms of perception. But the symbolism here is relatively crude, as compared with that involved in language, and it is less easy in those situations to control experimentally the combination of learning and sagacity which adequate intelligence scales require.

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[3] E. L. Thorndike, *The Measurement of Intelligence* (Teachers' College, 1927), p. 64.

TECHNIQUES OF MENTAL MEASUREMENT

The procedures of measurement are much the same no matter to what feature of psychological make-up they are directed. We may, therefore, best consider them in connection with the general topic of intelligence. This will make subsequent reference to them easy in the case of other characteristics as well. Mental measurement proceeds by inducing the individual to act in a standard situation, and noting the results. Such a standard process is commonly called a test. Often a test is a series of standard tasks or situations. Such a series may also be called a scale.

The test with which measurement begins is preferably a somewhat restricted task, situation, or process, which can be readily repeated, controlled, scored, and evaluated, in terms of the occurrence, characteristics, or nature of the response. Measurement is facilitated if the task involves but few types of material, few processes or functions or variables, definite and identifiable responses. Any task, performance, or act may become a test if it is submitted to the necessary series of standardizations.

Thus writing a poem, hitting a target, reading a sentence, defining a word, milking a cow, estimating space relations, and so on, may represent typical situations. They become tests when standard materials are prescribed, standardized technique adopted, standard instructions formulated and used, standard scoring methods devised. Such tests become instruments of measurement when the scores they yield can be translated into some standard scale or background of units, and interpreted as signs of facts with which they have been found to correlate to known degrees. Their predictive value varies with the closeness of this correlation.

Interest may lie in the process actually observed. Thus one might measure the speed and accuracy of typing of a candidate for a typist's position. Or interest may lie in the modification of such a process by some other influence, as when noting the effect of doses of caffein on the speed and accuracy of typewriting. Or the process may be taken as the sign of

other facts, as when typing after a given period of training is used as an indication of learning ability, adequacy of teaching methods, and the like. In the case of such characters as intelligence, samples of performances are chosen which may best represent that general level of intelligent conduct more or less characteristic of an individual. Or a long array of processes is utilized, the final score being some summation, average, or general indication of the array or some graphic representation of it.

Thus a group of individuals having had the same opportunity to master reading, writing, arithmetic, and spoken language might be measured individually. Sample tasks, such as adding, defining an array of words, completing a set of mutilated sentences, following printed instructions, giving the opposites of words, might constitute a battery of tests. Performance in these might then be used as measures of individual differences in the more general fields. Other things being equal, such differences would, therefore, indicate native differences in learning and sagacity, the single resultant being known as intelligence.

TEST CONSTRUCTION AND RECORD

From the point of view of construction, either or several of a number of principles may be followed. A *standard task* may be set for all individuals alike, the score consisting in the speed or accuracy of its execution. Form boards and puzzle boxes illustrate this method. *Homogeneous materials* may be used, the score consisting in the number of homogeneous units accomplished in a given time. Cancellation of specified letters from printed pages, and the substitution code performance are examples. Or *graded tasks* may be arranged in a hierarchy, with steps of increasing difficulty. The score is then the distance along the scale which an individual's competence will carry him, either with or without time limit. Thus in a vocabulary test words are often arranged in such a graded fashion. In the method of *miscellaneous gradations* the same principle is employed, except that the steps may consist of

tasks quite unrelated in character. The well-known Binet scale is an instance of this method. Finally, by the method of *response values* a standard stimulus or situation is presented, and the score consists in some qualitative or other evaluation of the response which is made, the nature of this not being specified in the instructions except in a general way. Thus the subject may be asked to speak the first word that comes to mind when a stimulus word is given. His score may then be derived by classifying his response in some category, as rhyme, synonym, contrast, etc. Or his response may be given a numerical value according to the frequency with which it is given by people in general. Similarly, spontaneous acts, such as drawings or compositions, may be rated.

From the point of view of record and interpretation there are also several commonly employed methods. *Original units* may be used, as in athletic scores, and measures of strength or speed. Or these raw scores may be variously translated in terms of predetermined backgrounds and scales which have a more easily understood meaning. They may be stated as *percentile units,* in terms of the rank of the subject, in a representative group of one hundred, if the scores were arranged in order from best to poorest. A related expression is that of *distribution units.* Here the raw score is divided by some measure of the variability of the group, the quotient showing the individual's position with respect to the average of the group of which he is a member. Much use is made also of *developmental units,* such as years of growth, school grades, and the like. For the raw score is substituted the average age of individuals who attain this score, or else the age at which this score is the average attainment. Finally *absolute units* may be devised, in which equal steps are laid off from a beginning or lowest point which represents just zero accomplishment. Such units may be "objectively determined," as in the case of inches and pounds. Or they may be "subjectively determined," as, for example, in various handwriting and composition scales where the steps are equal only in the sense that they are equally perceptible or equally often reported as different.

ILLUSTRATIVE TEST PROCEDURES

Some of these procedures may be easily illustrated from materials which we have already considered in this book. Thus in the chapter on "Quantitative Studies of Learning" a curve was given showing the way in which the time required for the completion of a standard substitution sheet varies with age, in the case of children. Suppose that a given individual requires for this task 180 seconds. We can see, by consulting the curve referred to, that 180 seconds is the average score of seven-year-olds. We may, therefore, translate this raw score of 180 seconds into terms of the age scale, developmental units. Thus we assign this individual to a seven-year level in this performance. This might then be called his "mental age" so far as this particular performance is concerned.

In the same chapter, experiments were described, using this test, with college freshmen. From data not there given but on record in the literature of mental measurement, we find that the average time required for this sheet by college freshmen is 125 seconds. The individual freshmen vary about this average. If we go 14 seconds above and below this average, we include the middle half of the freshmen between those two points (139 and 111 seconds). This distance, 14 seconds, is, therefore, called the "probable error" of this distribution of individuals. Our subject whose record is 180 seconds is inferior to the average freshman by 55 seconds. This is about 4 times the probable error. To go this far from the average freshman score would take us just down to the poorest freshman in the group, so that this subject would be given the 1 percentile standing among college freshmen.

Or we may use, by way of illustration, the word-building test described in the chapter on imagination. Suppose that a given subject makes thirteen words in that test, in the five minutes allowed. Using the table of "norms" for age given in the chapter, we find that this is approximately the score made by twelve-year-old girls and thirteen-year-old boys. If we combine the norms for boys and girls, and thus interpret the score of thirteen words, we find that this is the score made

on the average by thirteen-year-old children. The "mental age" of such an individual is, therefore, so far as this process is concerned, thirteen years.

Or if this subject is allowed three instead of five minutes, and makes a score of thirteen, this locates him as being 1 P. E. (one probable error) below the average college freshman. For the average freshman score is sixteen words, and the probable error (representing the variability of the freshmen about this average) is three words. A score of thirteen is just three words poorer than a score of sixteen words. Now to be at 1 P. E. below the average college freshmen is to be number twenty-five from the bottom or poor end, when the freshmen are arranged in rank according to their scores. Therefore, this subject is assigned the percentile standing of twenty-five among college freshmen.

These illustrations should serve to exhibit the chief features of the present methods of mental measurement. Other individuals, previously examined in large numbers, commonly constitute the actual "scale." The new individual is "measured" by locating him in this larger group or on this background of scores. Thus is revealed his relative standing in such a group, as on an age basis, a percentile basis, and so on.

RESULTS OF INTELLIGENCE TESTS

The widespread use of intelligence tests in recent years has had many and far-reaching results. Some aptitudes (such as pitch discrimination in human beings) are found to be rather highly specialized, restricted in scope, relatively elementary. Other aptitudes (as the use and understanding of symbols) manifest more general character, and may be used as the indexes of performance in numerous related tasks. The special aptitudes are measured by tests particularly adapted to their specific purpose. The general qualities are measured by attested intelligence tests and scales. Of these there are very many now available. They closely resemble one another in general conception and material. They differ somewhat because of variations in manner of standardization and number

of individuals on which the norms have been based. References to some of these are given in the Appendix.

Repeated and comparative results over a long period of years have clearly shown that such scales reveal a characteristic "quality" of the individual. When other factors are as nearly as possible equalized or eliminated, native learning and sagacity conspire to give the individual an "intelligence rating" which, if carefully and scientifically secured, has high significance. Such measures increase normally with advancing age up to or somewhat beyond adolescence. Thereafter they do not change as a function of age, except for the various deficiencies associated with growing aged.

The relative standing of an individual in a group of his peers, secured at a time so early even as the period of school entrance, does not materially change with age, if other factors are constant. The child who is at the ten percentile at the age of seven, if a given group is considered, is also found thereabouts at the age of sixteen, if the same individuals are available for comparison. The mental age of an individual may be divided by his chronological age, and the quotient is called his "intelligence quotient," often abbreviated as I. Q. The essential thing then is that the intelligence quotient of an individual, if correctly determined, is a fairly definite and constant characteristic of his mental make-up; it reflects the intellectual quality of his mind.

It is, moreover, closely related, along with other influences, to his career and destiny. It indicates very early his capacity for education of the usual symbolic or "higher" type. It prescribes within reasonable limits the modes of occupation in which he will have average, inferior, or distinguished success, if other things are constant as among different individuals. It indicates, with a surprising suggestiveness at least, the various modes of maladjustment in social and economic life, with which he will have difficulty or not. It does not, to be sure, indicate his honesty, thrift, temper, or musical ability, and so on. Any expectation that it will give accurate indications of such features rests only on a misapprehension of the nature of intelligence measurements. It is, however, an

important fact that intelligence as thus measured does yield positive correlation with other desirable characteristics.

Measurements of large sections of the population, as in the American public schools and draft army, along with accumulated studies of various smaller groups, reveal intelligence to be distributed approximately as represented in the graph of Figure 33. Along the base line are given the intelligence quotients. The area of the enclosed surface bounded by the curve above each section shows the approximate proportion (per cent) of the population at large who exhibit the various degrees of competence.

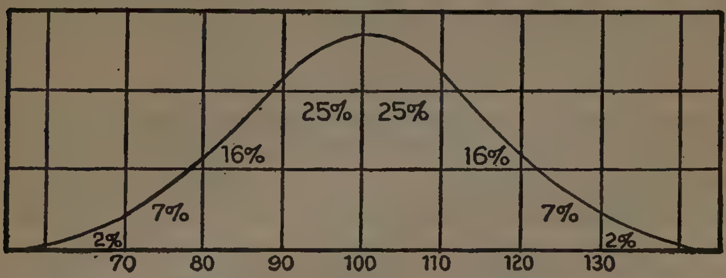

Fig. 33.—Showing the distribution of intelligence quotients in the general population.

Frequencies are indicated for various ranges of the intelligence scale, 100 being average or normal.

The average intelligence is represented as 100. The middle 50 per cent, ranging from I. Q. 90 to I. Q. 110, are conventionally regarded as the normal group. Approximately 2 per cent fall below an intelligence quotient of 70. These are commonly called feeble-minded. Between them and the normal group lie about 23 per cent of the population, to be characterized as dull. Approximately 2 per cent (perhaps slightly fewer) lie above I. Q. 130. These may be called intellectually gifted. Between them and the normal group lie about 23 per cent to whom the more moderate term "superior" might be applied.

The average intelligence of students in first-class American colleges has been located at about 130. The upper half of

such college students are, therefore, "intellectually gifted" as here defined. The average rating of high-school students is about 115, that of the grade schools being 100. An individual with I. Q. 120 may, therefore, be a brilliant pupil in the grades, where the children all come from the immediate neighborhood. In high school, with superior children selected from a larger area, such a pupil will be capable of only average work. And if this individual should attempt college work, his or her intelligence rating would be definitely below the average of other students in first-class institutions of collegiate grade. Such facts have led to the superstition that bright children deteriorate as they mature. The fact is, instead, that those with whose achievement theirs is compared become more and more highly selected.

Those inferior in intelligence are also, *on the average,* feebler in body, shorter in stature, lighter in weight, more susceptible to disease, shorter lived, and less resistant to the damaging influences of drugs and nervous stress. Children unusually gifted with intelligence are also, on the average, taller and heavier, more comely and better shaped, more agile, and stronger in foot pounds of work per unit of weight, than are those of average intelligence, of the same sex, age, and race.

"On the average," of course, leaves room for much individual variation. The correlated facts can by no means be used as diagnostic of the status of intelligence. Neither can intelligence measures predict the related features, in individual cases. Most of these data are derived from the study of children, and we have yet much to learn concerning the way in which intelligence and various other features of personal constitution conspire in the activities of adult life.

PSYCHOGRAPHIC ANALYSIS OF INDIVIDUALS

Psychographic analysis studies the constitution and equipment of the individual, noting the degree and pattern of combination of identifiable and measurable capacities or traits. Such examples as the following will illustrate this procedure: In Figure 34 are represented an array of measurements of the

aptitudes of two college students. The base line represents deviations from average (the point O), in terms of probable error units as explained in a foregoing section. The height of the column above each base-line region indicates the relative proportion of measures in which the individual deviated by that amount in the given direction from the score of the average college student of like age, sex, general training, and experience.

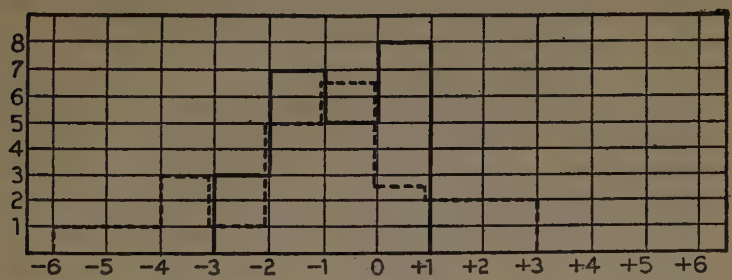

Fig. 34.—Distribution of deviations from average status in 24 measurements, of two college students.

The base line indicates deviations, in probable error units, above and below the average status (0) of college students. The vertical line indicates the number of measures in which the deviation was of a given magnitude. The solid line represents one student, the broken line the other.

Disregarding the nature of the aptitudes measured and noting only their spread or distribution along the scale represented by the base line, the two students are seen to differ conspicuously, although the average of their abilities shows them to be quite alike in this respect. But the measures of one are compact, homogeneous, differ relatively little from one another, all lying between —3 and +1 units on the scale. The measures of the other, instead, scatter widely over the scale, ranging from —6 to +3 units. In the first case four units of the scale contain all the individual's measures. In the second case nine such units are required to include the individual's heterogeneous degrees of aptitude. In the first case there are no marked abilities nor striking disabilities; in the second case there are both. Yet the average status of both individuals

is the same; both are somewhat inferior to the average college student on the whole.

Such differences in compactness or symmetry of equipment and capacity are important features of personality. They occur in spite of the general tendency toward the positive correlation of abilities, and have many points of interest for applied psychology (as in vocational and educational guidance.) It is, of course, important in such a mental analysis through measurement to know how far the differences indicated are constitutional, and how far they have resulted from previous training and special practice.

Such an analysis results in a "psychograph" of the individual's ability pattern or trait picture, in so far as the features measured involve mental activity. Individuals may also differ markedly in the nature as well as the compactness of their exceptional traits. Thus the two students, A and B, represented in the table opposite, were measured in the same array of tests. Their scores are given in P. E. units, as superior or inferior to the average (+ or —), and arranged in the table according to the order of excellence in them shown by student A.

It will be observed that A and B are very unlike in the nature of their strong and weak points. In all those performances in which A is superior, B is inferior to the average. On the other hand, in all the performances in which B is superior, A is below the average. In a few cases, both are below average and in two cases (Directions and Digit Span) their scores are quite alike. These are, to be sure, chosen as extreme cases, between which other college students would range. But such differences are genuine and of great significance in the analysis of individual make-up.

Although all the performances here listed are commonly called "psychological tests," only the first half dozen (all of them verbal) are found reliably to reflect "intelligence differences" in educated adults. The last six or seven in the column involve instead what might be called manual, motor, or simple perceptual activities. Student A is, therefore, superior in verbal activities and quite inferior to the average in the more

TABLE XX

Two College Students Differing Markedly in the Pattern of Their Aptitudes (Psychograph)

Performances Measured (Tests)	Scores in P.E. Units	
	Student A	Student B
Range and Accuracy of Information	+2.46	−2.62
Completion of Mutilated Sentences	+2.02	−2.02
Completion of Logical Analogies	+1.47	−4.22
Vocabulary Test (Whipple)	+1.31	−2.42
Naming Logical Opposites	+1.00	−6.00
Word Building (a-e-i-r-l-p)	+0.74	−1.11
Verb-Object Association	−0.53	+0.67
Recognition Memory for Proverbs	−0.60	+0.20
Recognition Memory, Unrelated Words	−0.91	−0.55
Color-Naming Test	−1.00	+0.04
Substitution Code Learning	−1.04	+1.46
Following Directions (Woodworth-Wells)	−1.35	−1.36
Word Naming, Uncontrolled Association	−1.47	+2.94
Number Checking Test	−2.12	+1.76
Coördination, Eye-Hand, Three-Hole Target	−3.30	+0.80
Memory Span for Digits	−3.76	−3.76
Knox Cube Test, Pintner Adaptation	−4.00	−1.00
Tapping Rate, Right Hand	−4.39	+1.27
Cancellation (Woodworth-Wells Test)	−5.40	+0.48

manual dexterities. Student B, on the contrary, exhibits just the reverse picture, excelling average college students in some of the lower activities and being quite inferior in the more highly symbolic activities that serve so well as indexes of intelligence.

If we consider only "competence," these two students differ only in the pattern of their organization. But the degree of symbolization involved in the various activities shows that actually A is intellectually bright. Student B is mentally dull, for a college student, but shows various aptitudes (not to be confused with intelligence) that may be serviceably employed elsewhere in life. When such inventories are extended to include a greater array and variety of activities and traits, mental measurement may afford practical as well as merely descriptive suggestions concerning human character and constitution.

CHARACTER

In addition to variations in learning and sagacity, as manifested in intelligence, human minds differ in many other respects. An important number of "traits" are roughly grouped under the head of "character." These refer in part to the social value of the individual's established modes of conduct. Honesty, thrift, promptness, truthfulness, loyalty, taciturnity, coöperativeness, sociability, credulity, are samples of an endless list of names applied to people and their behavior.

Many of these names refer not to strictly individual traits but to social resultants. They thus involve the reaction of one individual to another and are, therefore, traits of the pair or team, or of the situation. Individual A may coöperate with B but not with C. Should the coöperativeness then be attributed to A or to B? Apparently to neither alone, but to the combination. This is not a new situation, of course. The beauty of a picture, for example, depends on the beholder as well as on the independent picture. The clearness of an object depends not only on its own mechanical intensity but also on the preoccupation and interests of the listener. "To the pure all things are pure." We expect intelligence to show itself with whatever materials, and musical ability to function on any occasion. But coöperativeness, cheerfulness, stubbornness, patience, sociability, and the like, are not thus invariable.

Character traits are, therefore, often unstable and complex. Yet many social propensities distinguish individuals even at very early ages and persist throughout life. Our scientific knowledge of their origin and conditions is still very inexact. The very words we use for them are but loosely defined. But, on the whole, the so-called character traits seem to be at least as much matters of training and habit as matters of native inclination.

Many of them may represent habits and attitudes so early acquired that the occasions of their formation are no longer remembered. There may also be great individual differences of the native or instinctive sort, and character may vary with health, physical vivacity, economic and domestic felicity. It

is probable that the importance of heredity in character has been overestimated. In the chapter on subjective redintegrations we have suggested some of the ways in which such personal attitudes may arise and persist. Marked deviations from average in any of the psychological features, such as imagination, decision, reasoning, social perception, may also figure in daily speech as types of character. Most constitutive of character are special habits which involve the expectation, comfort, safety, or convenience of others.

TEMPERAMENT

Human beings differ, not only in intelligence and character, but also in ways which are vaguely called temperamental. Two workmen of equal trade skill and intelligence will, nevertheless, work in different ways. One is calm, the other easily excited; one steady, the other erratic; one hopeful, the other melancholy and predisposed to gloom. Predisposition toward emotional reactivity and inclination toward special feelings and moods are, indeed, what we usually mean by temperament. The essential difference between traits of character and those of temperament is that the first refer to overt acts, their social status and consequences; the latter to personal attitudes, evaluations, feelings, and emotions.

The most that scientific psychology can now offer on this topic is the suggestion that traits of temperament as well as of character are complex resultants. They are resultants, on the one hand, of native predispositions and acquired habits of action, feeling, thought, and speech. They are resultants also in the sense that they are not identifiable psychological processes. In them are involved all the individual variations, such as in learning, imagination, motivation, feeling, decison, attention. Many of the features both of character and of temperament depend also on peculiarities of intelligance.

Classifying the characters and temperaments of men is like classifying their occupations. Many classifications are equally feasible, and none of them reflects the intrinsic psychological factors involved. Such classifications, again, apply only to the

various extremes of human nature and leave the great mass of mankind without character and with no temperament, since they do not represent extremes. The ancients classified men into the jovial, the saturnine, the martial, the mercurial, the venereal, the lunar and the solar constitutions, on the basis of the presumed heavenly bodies under whose influence they were born. Or men were classified as sanguine, bilious, choleric, and phlegmatic, on the basis of the presumed bodily fluids dominant in their make-up. Many of these words persist, as names of relatively infrequent extreme pictures.

More recent tendencies take a descriptive trend, as when Mercier describes the "artistic temperament," the very different "temperament of the artist," the clever man, the capable, the envious, jealous, suspicious, religious temperaments, the faddist, the philosopher, the man of business, the practical man, and the man of action. Much has been said in recent years of the supposedly feasible classification of all mankind into "introverts" and "extroverts." Observation of the modes of mental and social maladjustment leads Rosanoff to describe several chief "types of personality," which are the normal, the antisocial, the cyclothymic, the autistic, and the epileptic.

The character and temperament of an animal constitute problems, not so much of its psychology, as of its natural history. Learning follows the same laws, be the lesson holy or profane. Imagination displays its special pattern, the mechanism of meaning is identical, be the import trivial or momentous. Decision has its established descriptive picture, whether the choice be of good or of evil. The minds of saint and sinner alike follow the redintegrative paradigm.

FIELDS OF PSYCHOLOGY

We may note briefly, in closing, the numerous related fields into which a survey of general psychology may lead. *Systematic* psychology, as we have seen, is occupied with the description of these general pictures and principles. *Developmental* psychology studies the genesis and growth of personal

mental systems and individualities. *Abnormal* psychology deals with the extreme variants, the aberrations and the inadequacies. *Physiological* psychology investigates in detail the nervous system, in its remarkable correlation with the systems of mental process. *Experimental* psychology seeks to render more precise the statements of fact and principle, and to extend the field of generalization. *Applied* psychology, in its many branches, points out the bearing of these principles on fields of practical endeavor. *Comparative* psychology studies especially the mental activities of the lower animals and of primitive men. *Social* psychology elaborates the mental aspects of individual minds in their mutual interactions and community relations.

APPENDICES

APPENDIX I

CLASSIFICATIONS OF AFFECTS, IMPULSES, TENDENCIES, EMOTIONS, INSTINCTS

The text has suggested that human feelings, emotions, motives and desires, are complex, as are also habits and purposes. They are so dependent on the circumstances of their occurrence, and on the past of the individual that no satisfactory classification seems feasible. It is, nevertheless, of some interest to know the nature of such classifications as have been attempted.

Some attempts endeavor to list such events in terms of their observable, subjective components. Others pay more attention to the stimulating occasions or circumstances. Others emphasize the results, by way of conduct or changed circumstances. Many are efforts to list the varied *past contexts* for which the present actual motives act as cues or surrogates. They are thus not lists of feelings or impulses so much as indications of situations which lead to definite feeling or activity, and may be represented later by symbols, with an impulsiveness derived from them.

The individual patterns of feeling may be very different in circumstances otherwise identical. They may be alike in situations descriptively the most diverse. Even very different complexes of feeling and emotion, introspectively, may be given the same name because of the circumstances in which they arise or the results to which they lead.

From the point of view of applied psychology, it is convenient to have tentative lists in which the most easily recognizable and namable feelings, the most common fundamental tendencies, and the more urgent drives of human beings are indicated. A number of such classifications, proposed by various psychologists, are given in this Appendix. A comparison of them will reveal some of the difficulties involved in such classification.

A. HUMAN REFLEXES

H. C. Warren, in his *Human Psychology* (Houghton Mifflin, 1919), p. 101, gives a list of sixty-seven human reflexes, classified in groups according to their characteristic degree of modification in the course of life.

B. CRAVINGS AND BODILY FEELINGS

Knight Dunlap, *Elements of Scientific Psychology* (Mosby, 1922), presents a very instructive chapter (Chap. XV) on "Affective Experience," in most respects consonant with the point of view of the present text. He suggests one or two tentative classifications which have considerable interest. The first is a classification of "simple feelings." Of these he writes:

> There are a number of feelings which appear to be simple, and which may be considered as at least *relatively* simple:
>
> (1) suspense, (2) disagreeableness, (3) pleasantness, (4) excitement, (5) fatigue, (6) strain, (7) relaxation, (8) depression, (9) thirst, (10) fullness (of alimentary canal and bladder), (11) emptiness, (12) malaise, (13) nausea, (14) dizziness, (15) exhilaration, (16) interest, (17) a localized sex-feeling, (18) suffocation, (19) relief, (20) satisfaction, (21) revulsion, (22) tender feeling, (23) anticipation, (24) choking, (25) retrospection, (26) desire, and, of course, pressure, pain, warmth and cold. Undoubtedly there is an enormous number of other feelings which are as nearly simple as these, but which have not as yet been analyzed out of the complexes in which they occur.

Dunlap then calls attention to the great complexity of most feelings, in the following words, giving also a number of clear examples in the course of the chapter.

> The great mass of feelings, such as hunger, pleasure, joy, sorrow, fear and the whole list of emotions, seem to be complexes of the feelings named above, together with feelings as yet unnamed, and the great variation in these emotions and other complex feelings undoubtedly depends upon the variation in the elements or radicals present. These variations are so great that there is no possibility of a sharply defined classification of the emotions.

Dunlap gives also a tentative list of "fundamental human desires." He defines desires as "feelings of special importance, apparently vital in their bearing on life." Further: "While it is true that in many cases desires are differentiated solely by their objects, it seems probable to the author that there are several fundamentally different desires and that these desires are resident in specific parts of the organism." The elementary character of the following listed desires is stated only tentatively. The desires as described are "designated by their most common objects, but this is merely a matter of description; ultimately we must identify them in some more direct way" (pp. 323, 324).

The list of desires which is proposed as fundamental is as follows:

1. Desire of aliment (food and drink).
2. Desire of excretion (to be rid of disturbing things).
3. Desire of rest.
4. Desire of activity.
5. Desire of shelter (protection from disagreeable factors in the environment).
6. Desire of conformity (doing as others do, or as a leader does).
7. Desire of preëminence (leadership).
8. Desire of progeny (parental desire).
9. Desire of sex gratification (amatory desire).

C. MCDOUGALL'S LIST OF INSTINCTS

William McDougall, in his *Outline of Psychology* (Scribner, New York, 1923), adheres to a general point of view previously advocated in his *Social Psychology*, and finds no great difficulty in enumerating the chief instincts of man and the primary emotional qualities. Each primary "emotion" is "an indicator of the instinctive impulse at work; its bodily expressions serve to indicate the nature of the impulse to our fellows and to evoke in them the same instinctive impulse, attitude, and emotional excitement; and the emotional quality serves also to indicate, to the subject himself, the nature of his excitement and the kind of action to which he is impelled" (pp. 325, 326).

The following parallel list of human instincts and primary emotional qualities (emotions) is suggested (p. 324):

Names of Instincts (Synonyms in Parentheses)	*Names of Emotional Qualities Accompanying the Instinctive Tendencies*
1. Instinct of escape (of self-preservation, of avoidance, danger instinct)	Fear (terror, fright, alarm, trepidation)
2. Instinct of combat (aggression, pugnacity)	Anger (rage, fury, annoyance, irritation, displeasure)
3. Repulsion (repugnance)	Disgust (nausea, loathing, repugnance)
4. Parental (protective)	Tender emotion (love, tenderness, tender feeling)
5. Appeal	Distress (feeling of helplessness)
6. Pairing (mating, reproduction, sexual)	Lust (sexual emotion or excitement sometimes called love—an unfortunate and confusing usage)
7. Curiosity (inquiry, discovery, investigation)	Curiosity (feeling of mystery, of strangeness, of the unknown, wonder)
8. Submission (self-abasement)	Feeling of subjection (inferiority, devotion, humility, attachment, submission, negative self-feeling)

Names of Instincts (Synonyms in Parenthesis)	*Names of Emotional Qualities Accompanying the Instinctive Tendencies*
9. Assertion (self-display)	Elation (feeling of superiority, masterfulness, pride, domination, positive self-feeling)
10. Social or gregarious instinct	Feeling of loneliness, of isolation, nostalgia
11. Food-seeking (hunting)	Appetite or craving in narrower sense (gusto)
12. Acquisition (hoarding instinct)	Feeling of ownership, of possession (protective feeling)
13. Construction	Feeling of creativeness, of making, of productivity
14. Laughter	Amusement (jollity, carelessness, relaxation)

McDougall also recognizes several "minor instincts," such as "scratching, sneezing, coughing, urination and defecation," which are "so simple in their bodily expressions that we cannot recognize as specific qualities the excitements which accompany their exercise." In addition to the list of emotions here given, McDougall also describes various secondary or "blended" emotions and also a list of "derived emotions." For the description and enumeration of these the book itself should be referred to. It should be noted that "sleep" is given no place in this list, although it is surely as "instinctive" an act as human beings ever commit.

D. WARREN'S CLASSIFICATION OF INSTINCTS

H. C. Warren, in *Human Psychology* (Houghton Mifflin, Boston, 1919), gives on p. 106 a list of "the chief kinds of instincts" classified in five groups. On p. 299 of the same volume he lists "the more important human emotions," relating them to the instincts which are their bases. The respective chapters of this book should be read. Warren enumerates twenty-six instincts and thirty-eight emotions in the tables referred to. The classification of instincts is as follows:

1. *Nutritive*
   - Metabolic expressions
   - Walking
   - Feeding
   - Wandering (hunting)
   - Acquiring (hoarding)
   - Cleanliness
2. *Reproduction*
   - Mating (sexual attraction)
   - Maternal
   - Filial (of infancy).

3. *Defensive*
    - Flight
    - Subjection
    - Hiding
    - Avoiding
    - Modesty (shyness)
    - Clothing (covering)
    - Construction (home-making)
4. *Aggressive*
    - Fighting
    - Resenting
    - Domineering
    - Rivalry
5. *Social Organization*
    - Family (parental and filial)
    - Tribal (gregarious)
    - "Apopathetic"
    - Sympathetic
    - Antipathetic
    - Coöperative

In addition to these Warren lists a number of "instinctive tendencies." "An instinctive tendency is a mode of behavior comprising many distinct sorts of action, all of which are individually learned, but which resemble one another in general type; the 'type' itself is not learned but belongs to the constitution of the species" (p. 107). The "instinctive tendencies of the human species" are:

Imitativeness
Playfulness
Curiosity
Dextrality (right-handedness)
Esthetic expression
Communicativeness

E. THORNDIKE'S POINT OF VIEW

A definite and vigorously expounded point of view, in many respects consonant with that of the present text, is represented by Thorndike's account of "The Original Nature of Man." See his *Educational Psychology: Briefer Course,* Part I, from pp. 4, 5, of which the following suggestive paragraph is quoted:

There is of course no gap between reflexes and instincts, or between instincts and the still less easily describable original tendencies. The fact is that original tendencies range with respect to the nature of the response from such as are single, simple, definite, uniform within the

individual and only slightly variable amongst individuals, to responses that are highly compound, complex, vague, and variable within one individual's life and amongst individuals. They range with respect to the nature of the situation from simple facts like temperature, oxygen or humidity, to very complex facts like "meeting suddenly and unexpectedly a large animal when in the dark without human companions," and include extra-bodily, bodily, and what would commonly be called purely mental situations. They range with respect to the bond or connection from slight modifiability to great modifiability, and from very close likeness amongst individuals to fairly wide variability.

Much labor has been spent in trying to make hard and fast distinctions between reflexes and instincts and between instincts and these vaguer predispositions which are here called capacities. It is more useful and scientific to avoid such distinctions in thought, since in fact there is a continuous gradation.

F. A BIOLOGICAL CLASSIFICATION OF EMOTIONS

Seashore in *Introduction to Psychology* (Macmillan, New York, 1923), pp. 330-337, suggests that:

Undoubtedly the most satisfactory general classification of emotions should be analogous to our biological classifications of plants or animals in which we make a progressive series of differentiations, starting with the group as a whole and ending with fine ramifications which identify the individual. Mercier devoted a large volume, *The Nervous System and the Mind,* published in 1888, to the development of such a classification. . . . I have simplified his terminology and have reduced his elaborate treatment to an outline representing a classification of feelings and emotions. . . . The sample of this classification is submitted not as an approved or adequate grouping of feelings, but primarily as a suggestion indicating the probable trend of future organization within this field, and as a very excellent basis for exercises in the critical discussion of classification.

His first large division in this classification is made on the basis of *purpose served,* in which he recognizes three large groups: (I) the conservation of the organism, (II) the conservation of the species, and (III) the conservation of the social group. . . . Taking the first of these, we divide them into A and B, according as they are initiated by the environment or by the organism. Group A we divide into 1 and 2, according as the correspondence is direct or indirect. Group 1 embraces what we may call the affective tone in perception. Group 2 may be divided on the basis of the character of the agent, according as the agent is (*a*) actively noxious, (*b*) passively noxious, (*c*) beneficent, or (*d*) and (*e*) mixed. The first of these may again be subdivided on the basis of the power of the noxious agent, according as it is recognized as overwhelming, superior, equal, inferior or insignificant. The first of that subdivision may be divided according as the noxious agent elicits or does not elicit active counteraction, or is not known with certainty.

Where the agent elicits counteraction, it may be incipient, voluntarily suppressed, or actual. If actual, it may be successful or unsuccessful.

I present here only group I of this classification, partly because that is adequate to illustrate this principle of classification, and partly because groups II and III are not regarded as satisfactory. The following classification deals, therefore, only with those feelings and emotions which serve the purpose of conserving the organism.

This section of the classification is here reproduced.[1] The reader should consult Seashore's chapter for further details and for consideration of the advantages of such a classification.

A Biological Classification of Feelings and Emotions (Seashore)

(Adapted from Mercier, *The Nervous System and the Mind*)

I. Those which primarily affect the conservation of the organism
- A. Initiated by the environment
  - 1. Correspondence direct: The affective tone of the sensations—light, color, tone, taste, smell, pressure, strain, cold, warmth, equilibrium, pain
  - 2. Correspondence indirect: Feelings and emotions proper
    - *a.* Antagonism: Agent known as actively noxious and of
      - 1) Overwhelming power, and
        - *a*) Does not elicit counteraction .... *Terror*
        - *b*) Elicits counteraction which
          - Is incipient .... *Desperation*
          - Is voluntarily suppressed .... *Resignation*
          - Becomes actual and is
            - Successful .... *Triumphant Exultation*
            - Unsuccessful .... *Despair*
      - 2) Superior power, and
        - *a*) Does not elicit counteraction .... *Fear*
        - *b*) Elicits counteraction which
          - Is incipient .... *Courage*
          - Is voluntarily suppressed .... *Patience*
          - Becomes actual and takes a passive form..... *Stubbornness*
          - Is successful .... *Triumph*
          - Is unsuccessful .... *Defeat*
        - *c*) Is not known with certainty .... *Apprehension*
      - 3) Approximately equal power, and
        - *a*) Does not elicit counteraction .... *Hate*
        - *b*) Elicits counteraction which
          - Is incipient .... *Anger*
          - Is delayed .... *Revenge*

---

[1] C. E. Seashore, *Introduction to Psychology* (copyright, Macmillan Company, 1923; reprinted by permission), pp. 332 *ff*.

Is voluntarily suppressed .... *Patience*
Becomes actual and
Takes a passive form .... *Sulkiness*
Of moderate intensity .... *Rage*
Of extreme intensity .... *Fury*
Is successful .... *Victory*
Is unsuccessful .... *Mortification*
Is not known with certainty .... *Suspicion*
4) Inferior power, and
a) Does not elicit counteraction........................ *Annoyance*
b) Elicits counteraction which
Is incipient .... *Vexation*
Is delayed .... *Resentment*
Is voluntarily checked .... *Meekness*
Becomes actual and is
Successful .... *Satisfaction of Success*
Unsuccessful .... *Mortification*
5) Insignificant power and
a) Does not elicit counteraction........................ *Contempt*
b) Elicits counteraction .... *Scorn*
b. Repugnance: Agent known as positively noxious
1) To the taste, and
Moderately noxious .... *Disgust*
Intensely noxious .... *Loathing*
2) In other ways, and
Not of superior power .... *Dislike*
Of superior power .... *Abhorrence*
Of overwhelming power .... *Horror*
c. Kindly feelings: Agent known as beneficent
1) Actively, and
Not of overwhelming power .... *Gratitude*
Of overwhelming power .... *Reverence*
2) Passively, and
Not of overwhelming power .... *Liking, Affection*
Of overwhelming power .... *Devotion*
d and *e*. Grievous and joyous feelings: An event known as:
1) Noxious, and
Distant in time .... *Anxiety*
Impending .... *Dread*
Imminent .... *Alarm*
Does not occur .... *Relief*
Has happened .... *Anguish, Grief, Sorrow, Regret*
2) Beneficent, and
Impending .... *Pleasurable Anticipation*
Imminent .... *Eagerness*
Does not occur .... *Disappointment*
Has happened .... *Joy, Delight, to Gratification*
B. Initiated by the organism
1. The affective phase of conation
2. The feeling of effort

3. The feeling of abstract sense qualities, such as resistance, hardness, softness, elasticity
4. Feelings of content and discontent: relation of activity to outlet
   a. Activity exceeds outlet
      In the case of a single activity .... *Desire*
      In the case of many activities .... *Ennui*
      When the disproportion is prolonged .... *Discontent*
   b. Outlet is proportional to activity
      Single activity .... *Satiety*
      Many activities .... *Blaséness*
5. Feeling of freedom and restraint: relation of activity to obstacle
   Obstacle, as compared with activity
   Insignificant .... *Freedom*
   Overwhelming .... *Restraint*
   Equal .... *Determination*
6. Feeling of power: relation of exertion to effect
   Exertion as compared with effect
   Insignificant .... *Power*
   Slight .... *Ease*
   Considerable .... *Difficulty*
   Overwhelming .... *Impotence*
7. Feelings corresponding to ratio of success to failure
   a. Success predominating
      In important matters .... *Self-reliance*
      In small matters .... *Complacency*
   b. Failure predominating
      Decidedly .... *Depression*
      Greatly .... *Despondency*

G. THE CHIEF HUMAN NEEDS

The following paragraphs are an adaptation from a chapter[2] by the present writer on the applied psychology of human engineering. They present a practical, naturalistic, as distinguished from a psychological account of human instinct, feeling, and motivation. They are given here as a convenient account which may be easily related to the general point of view of the text. The distinctions and the classification are confessedly tentative and opportunistic, but they seem to serve a useful purpose in applied psychology.

The chief needs of men and women are based either on their native and instinctive tendencies or upon their firmly established habits. In

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[2] Tipper, Hotchkiss, Hollingworth, and Parsons, *The Principles of Advertising*, (copyright, The Ronald Press Company, 1925; reprinted by permission).

both cases the circumstances and early training of life are such that all members of the race come to possess much the same fundamental equipment of desires and possible satisfactions. They vary in the strength of the urges and in their preferred modes of satisfaction or alleviation.

The instinctive tendencies we may suppose to have originated in the early history of mankind, as convenient tools in the struggle for existence and safety. Both animals and primitive man found certain modes of reaction to be most effective when dealing with particular objects and situations. Those who, by accident or heredity, reacted promptly in these appropriate ways, survived and left offspring who possessed the same favorable and inborn tendencies to reaction. Those who failed in these appropriate ways perished and left no progeny. So a constant selection was made of individuals conforming to the most effective type. These reaction tendencies are the reflexes and instincts.

The universal habits may also be the basis of fundamental cravings and needs. The conditions of life and social existence are so similar in the case of all times and places that all infants early acquire more or less the same array of habits in certain respects. Thus every child is born to another person, becomes at once a unit in the family group, constantly accompanied by others in his early years, and early learns to associate the presence of others with many varieties of pleasure and satisfaction. So fully adapted does the infant become to the presence of other people of his kind that when they are nowhere to be found he feels lost and uncomfortable, and may engage in restless activity and random wandering until he finds others of his kind. When this is the case we say that he is gregarious or has a positive craving for the society of others. But there is no reason to suppose that the longing for companionship is an instinct, in the biological sense. It is an acquired habit, and the lost feeling when others are absent is quite like the feeling of the chronic smoker who cannot find his pipe or has neglected to provide himself with tobacco. Such fundamental needs, based upon experience and learning, when common to most of the members of the race, we may call tendencies as distinguished from instincts, or we may still better include both instincts and habits in one general group of fundamental tendencies.

When we speak of special tendencies we do not mean perfectly definite and distinct sets of movements which will be executed in the same way on all occasions. Instead we mean a somewhat loosely classified set of special connections between situation and response, each connection being itself definite and specific, and the various connections being more or less related on the basis of their consequences, the type of satisfaction they bring, or the kind of object that provokes them.

Thus the fundamental tendency which we name "curiosity" does not lead us always to do some one particular thing or series of things. Instead, to things which are new, or sudden, or unexpected, or in motion, or intense, or in other ways novel or unusual, we respond by varied movements, such as turning the head, pricking up the ears, craning the neck, extending the hand, prodding with the foot, and the

like. The particular movements and the situations inducing them may be infinitely varied, but in general, the situations are novel and unfamiliar and the reactions are inquisitive, explorative and investigatory. This is why we group the various specific connections together under the name "instinct of curiosity."

So it is with all the fundamental tendencies to which we shall refer. The important thing, from the point of view of human engineering, is that by the time the individual is mature he is equipped with an array of fundamental cravings and reaction tendencies which are more or less common to all the members of his race, and which constitute, either directly or through their symbols, the great driving forces of his life and the motives of his institutions and choices.

The gratification of one of these fundamental tendencies is a source of satisfaction, and the failure of its gratification is a source of discomfort and annoyance. Thus the feelings and emotions are closely associated with the fundamental tendencies. This is often expressed by the statement that each instinct is the basis of a corresponding emotion. The instinct is a tendency to react; but the reaction is not only through the hands, feet, speech organs, and other overt or external mechanisms; there are also internal bodily reactions, such as the acceleration of the pulse, impediment to breathing, gulping, gasping, choking, flushing, changes in the secretions of the glands and so on. It is in large measure the awareness of these internal bodily disturbances that constitutes what we call feeling or emotion. Thus "fear" means either a way of acting or a way of feeling.

Even in the highest stages of civilization the needs of men and women can, for the most part, be traced back to the fundamental needs of animals and primitive peoples. The main differences are in variety, subtlety, ease of modifiability, and susceptibility to training which characterize the needs of civilized people. Three tendencies of this sort may be pointed out.

(*a*) The various elementary instincts persist, and perhaps new forms are added, but they tend to become less and less specific and more modifiable. The reactions of the lower animal occur after all in a more or less ironclad way, and relate to definite objects and situations in his life. Thus the bee could scarcely be persuaded to collect gold dust instead of honey; but the human being readily substitutes one object of satisfaction for another. The human being shows fundamental and early tendencies which may be directed toward new objects and situations, and the original needs and response tendencies may be very much elaborated, modified and otherwise changed by education, entreaty, appeal, argument, example, and experience.

(*b*) Elaborate traditions, customs, sanctions, are developed, which are treasured and perpetuated in art, in education, in religious and civic ceremonial. These become early impressed on the individual, and, once impressed, they assume the coerciveness of original instincts. To all of them correspond new needs and cravings which must also be satisfied. The demands for clothing and for bodily adornments such as jewelry represent such institutions. Indeed these new institutional needs may even become more urgent than the cruder instinctive crav-

ings, since they are supported and encouraged by the sentiment of the community, the sanction of the state, the verdict of history, or at least by the standard of living of one's immediate circle of friends.

Thus a man may risk bodily safety to secure a more stylish overcoat, or a woman may sacrifice the happiness of her child in order to secure a larger array of sparkling ornaments. Cleanliness, clothing, chivalry, piety, chastity, patriotism, coöperation, and countless habits of daily life, needs of the moment, requirements of this and that occupation or class, illustrate these new needs which characterize human beings.

(*c*) In the struggle to achieve many of these desires, certain still more varied and distinctively social values arise, values which serve mainly to distinguish one individual from another, one class from another, one group from other groups, in the eyes of the community at large. Ideals of style, fashion, prestige, exclusiveness, propriety, etiquette, all the vagaries and fads and fancies of the leisure class—these no less than the more biological necessities of existence constitute human needs, either immediate or symbolized in thought. They form triggers of reaction, explosive points of response, which need but to be touched off to bring about vigorous behavior. Such effective conceptions, habits, standards, and ideals, along with the social needs, values, and sanctions, combine with the elementary instinctive requirements and the fundamental organic necessities.

In the following table a rough classification is made of these fundamental tendencies, however acquired or derived. Along with the general name in the first column is given a selection of other terms, either synonyms or names of feelings which are readily namable and characteristically go with the situation indicated. In the second column the name is somewhat expanded, by indicating the situation and the characteristic acts involved in the tendencies named.

Fundamental Tendencies and Related Feelings	*Situations and Typical Behavior to Which the General Name Commonly Applies*
Appetite (hunger, thirst, sensuous enjoyment)	We sustain the body, gratify and exercise the senses, and continue their stimulation so long as the stimulation remains pleasant.
Comfort (ease, relaxation, restfulness, calm)	We avoid pain or distress by flight, by removal of the stimulus, or by overt acts of evasion and search
Sex (passion, lust, love, coquetry)	We make definite responses toward the other sex or toward particular members of it who attract or stimulate us to such acts.
Devotion (loyalty, faithfulness, affection)	We protect and support our dependents, those with whom we have been pleasantly associated, or whom we identify as members of our group.

Fundamental Tendencies and Related Feelings	*Situations and Typical Behavior to Which the General Name Commonly Applies*
PLAY (sport, joy, humor, merriment)	We work off superfluous energy, alone or with others; we tease or banter, and enjoy this process in person or vicariously.
FEAR (timidity, caution, fright)	Retractile or inhibitory reactions before definitely dangerous objects known to be such, or to which we have no ready adaptive responses.
ACQUISITIVENESS (thrift, selfishness, jealousy)	We accumulate and store up objects, we save, bargain, and collect.
SOCIABILITY (loneliness, hospitality)	We form groups, seek companions, and react to adjustments of other members of our group.
COMPETITION (emulation, rivalry, ambition)	We dominate inferiors; rival our equals; and are jealous of our superiors in any respect.
CURIOSITY (interest, inquisitiveness)	We examine or explore novel objects for which adaptive responses are felt to be ready.
SHYNESS (modesty, bashfulness, reserve)	We avoid strange objects and situations which are felt to be superior though well disposed, and for which there is uncertainty of appropriate response on our part.
ORNAMENTATION (display, pride, exhibitionism)	We decorate our person and belongings and try to exhibit self and property in favorable light.
IMITATION (propriety, conformity)	We show more or less general tendencies to act as others act, to behave with the crowd, or we soon learn to do so by penalty.
ANGER (resentment, hatred, revenge, irritation)	We resent, by overt attack or otherwise, the aggression of others against ourselves or those to whom we are devoted.
CLEANLINESS (purity, innocence, decency, honor)	We abhor dirt, both literally and figuratively; we conceal or remove filth from our person or our belongings.
WORSHIP (piety, faith, admiration, reverence)	We respect, do obeisance to, and feel subordinated to those who are hopelessly our superiors.
CONSTRUCTIVENESS (workmanship, artistic impulse)	We build, create, invent, construct, for gain and for the pleasure of success and manipulation.
SYMPATHY (pity, sorrow)	We aid the unfortunate, especially those who suffer in ways in which we have ourselves suffered.

Fundamental Tendencies and Related Feelings	*Situations and Typical Behavior to Which the General Name Commonly Applies*
CUNNING (intrigue, secrecy, slyness, deceitfulness)	We plan in secret, gossip, circumvent, employ strategy and subterfuge, and may even commit crime from such motives.
PRIDE (self-esteem, conceit, hauteur)	We favor our own work, personality, opinions, possessions, abilities, and connections, and place high estimates on self-worth.
GRATITUDE (thankfulness, gratefulness)	We feel and act well disposed toward the sources of our satisfactions.
COMEDY (amusement, hilarity, laughter, glee)	We tease and banter or enjoy seeing others teased or bantered by other people or by the circumstances of life.
HARMONY (beauty, balance, proportion, symmetry, and the æsthetic feelings)	We continue, effect, or enjoy arrangements of materials in time or space, or in other relationships, which display such qualities as those indicated, including also rhythm, melody, and the various art forms.
SLEEP (drowsiness, relaxation, obliviousness)	We fall into somnolent stupor periodically or in response to special stimuli or situations, or in mild forms feel bored and drowsy.

A number of studies have been made of the relative strength of various human needs and drives. A summary of these results may be found in A. T. Poffenberger, *Psychology in Advertising* (Shaw, 1925), Chaps. II-IV, along with a brief account of the nature and inventory of human needs, and their importance in human engineering.

APPENDIX II

PROJECTS, QUESTIONS, AND EXERCISES

CHAPTER I

1. How might you determine whether one thing is causally related to another?

2. Cite two illustrations of customary sequence that do not seem to constitute cases of cause and effect. How reconcile them with the statements made in the text?

3. Describe two changes or events that involve strictly mechanical sequence.

4. Ask a number of friends what they mean by "mental." Compare their replies and consider the precision with which the word is ordinarily used.

5. Do dogs ever exhibit redintegrative behavior? Cite an illustration.

6. Do you know of any plant behavior that is redintegrative in character?

7. Why does a horse sometimes shy at a spot where it was once frightened? Give the simplest possible explanation.

8. A pup, mistreated by its master, would not allow men to come near it, but approached women without hesitation. Why?

9. Cite, from your experience, an actual case of some emotion, other than fear, aroused by partial details of its original cause. Consider such emotions as anger, joy, affection, aversion.

10. Try to state precisely why the person who had been "thinking of shoes" read the flash-card inscription as "button."

CHAPTER II

1. Enumerate five of each of the following, not cited in the text: qualities, relations, series, objects, classes, processes, situations.

2. Make statements using the word "subjective" in each of the four ways described.

3. Name other word pairs which in their common use distinguish sharply between the extremes of really continuous series.

4. List five topics on which different individuals would agree

closely; five on which they would disagree widely; five on which the agreement would be medium.

5. List five things you feel sure are physical; five that are surely mental; five on which you are doubtful. How do they differ?

6. Describe some occasion on which you had to decide whether a thing was subjective or objective. How did you proceed?

7. Read Helen Keller's study of her life, observing the ways in which she learned about things she could not possibly observe.

8. How would you decide whether or not a given person is conscious?

9. Why are inferences about the "consciousness" of lower animals insecure? How about the consciousness of plants?

10. Read the general account of "consciousness" given in some other textbook of psychology, and compare it with that of this chapter.

CHAPTER III

1. Analyze the work of the historian, showing the way in which he undertakes the typical tasks of a science.

2. To what extent do music, Latin, composition, mathematics, undertake these tasks? How satisfactorily can subjects be sharply classified as being or not being sciences?

3. Observe in the psychological laboratory any available instruments or devices for facilitating scientific observation, such as chronoscope, tachistoscope, stereoscope, color-mixer, Galton bar.

4. Describe some of the special techniques of report and record developed by some science with which you are familiar.

5. What are some of the "statistical methods" or formulas adopted by many sciences? Why are they required? Why does psychology have special need for statistical procedures?

6. Which of the following terms represent generalizations and which conjectures: digestion, heredity, health, energy, germ, electron, custom?

7. Describe some scientific conjecture that has been abandoned; one that has been confirmed.

8. Describe purely private experiences of yours that are closely correlated; correlations of other objective facts in addition to those cited in the text; show how some of your subjective experiences are correlated with objective conditions.

9. If a psychological reading room or reference shelf is accessible, inspect the books, recording the various practical fields in which psychology is applied. What psychological journals are in the library? Can you find a list of such journals, so far as they are published in this country?

10. Examine some general book on applied psychology, for a view of the fields and methods of application there described.

CHAPTER IV

1. Observe some case of anger. Point out the "situation" arousing it, and the facts constituting it, observing their complexity.
2. Name two objects strictly in the same class; two with but slight class relationships; two as completely as possible in different classes.
3. State precisely what is meant by writing the same word twice; reading the same story twice; having the same headache twice; hearing the same noise twice.
4. Some writers find it difficult to work in unfamiliar places, with strange pens, and paper of unusual color. Why might this be?
5. Can you see any reason why a child might be able to spell a word at school but not at home?
6. Why is a nervous breakdown often relieved by a change of scene?
7. Why is it a good plan to rehearse one's lines on the very stage from which they are to be delivered finally?
8. A man was once taken violently sick in a favorite seat at the opera. Thereafter he had to release his subscription, since every time he sat in the seat he felt nauseated. What is the simplest explanation?
9. An eastern business man had spent his early years in the arid regions of a western agricultural state. Now whenever it rains he whistles and sings, and feels generally elated, whereas his associates are gloomy instead. Can you suggest any explanation?
10. Can you give a simple psychological reason why primitive men sometimes feared to speak the name of the enemy?

CHAPTER V

1. Fit the experience and behavior of the neurotic soldier into the mental paradigm on p. 51, substituting actual events for the letters.
2. Why do pigs come running when the farmer gives the feeding call? If more than one explanation is suggested, which is the most satisfactory, and why?
3. See if you can discover who the psychologists of your state are, where the psychological clinics are located, and where there are psychological laboratories.
4. Explain in your own words just what is meant by a conditioned reaction.

5. Just why, in your own words, is the conditioned reaction only half a description of the simplest possible mental situation?

6. How would you teach a dog to beg, by the method of conditioning? How teach him to come when you whistle?

7. Is there any possibility that one's mouth waters at the inviting odor of food? If so, why?

8. Can you explain why some people are unable to go to sleep without a light in the room, while others can sleep easily only if the lights are extinguished?

9. Did you ever mistake a stranger for an acquaintance? Can you explain the event along the lines of this chapter?

10. Why does the burnt child dread the fire?

CHAPTER VI

1. If you ever had an hallucination, how did you recognize it as such?

2. Describe the objects on your breakfast table this morning by calling them up in your mind's eye. How do the various things appear? Where?

3. Recall some complex experience such as being at the seashore, trying to get vivid imagery of all the features. Can you get equally good images of the sights, sounds, contacts, odors, and so on? If not, how do they differ?

4. Recall your dreams of some night and report all the imagery that seems to have appeared, noting the relative contribution of the various senses.

5. Examine yourself carefully for such synæsthesias as you may have, and describe them.

6. If you have synæsthesias, see if you can trace their probable genesis.

7. Observe carefully how you picture the number series, or the successive dates of history. Do you have anything that could be called a number form? Can you account for its character?

8. Look steadily at a piece of green paper, then quickly look at a gray wall. Describe the negative after image that appears on the wall. Try other colors, and report your findings.

9. Try to give a redintegrative explanation of some of your personal dislikes or preferences. Do you often try instead to find "rational" grounds for them? Illustrate.

10. Describe some personal attitude toward a topic or institution that is probably traceable to your original reaction to some person.

CHAPTER VII

1. Describe some firm bit of your knowledge derived solely from the verbal report of others. Do you mistrust it because of its mode of acquisition? Is this generally the case?

2. Note what happens when you "commune with yourself" on some topic. What sort of "language" do you seem to use on such occasions?

3. Try to teach some animal, as a dog, horse, bird, cat, to respond definitely to a spoken signal. Describe your method and try to explain the degree of success or failure.

4. What is the "direct method" of teaching foreign languages? What are some of its psychological advantages and practical difficulties?

5. To what degree or in what sense are the cries of lower animals (barking, mewing, squealing, mooing) to be designated language? Are they speech?

6. Try to teach an infant to understand and use some word, by the methods here described, and report your experiment as it proceeds from day to day.

7. Why are deaf children also likely to be mute?

8. Describe the way you learned stenography, the Morse code, or the manual sign language. Diagram an act of such learning in terms of the mental paradigm, as on p. 51.

9. Can you indicate other facts or situations for which we have no single words or names in English? Do other languages have names for these, so far as you know?

10. Try to find, for each general redintegrative law, another illustration from language, if possible one of quite different sort from that given in each case in the text.

CHAPTER VIII

1. Sit quietly and note the way in which the vague background is analyzed into its components. Describe the items, and their order of appearance and relative prominence.

2. Describe the way in which "new parts," originally not noted, gradually were discovered in some object.

3. Young children often define things (as a hat, chair, table) in terms of their use. How adequate is such a definition? What are the "logical" requirements of a definition?

4. The doctrine of "creative synthesis" teaches that parts may combine to produce new resultants with unique and novel properties.

Consider the applicability of such a doctrine in chemistry, architecture, music. Is it really an explanation?

5. Catch yourself in a typical act of perception and describe as well as you can just what took place in the process.

6. If society is not something more than the sum of the individuals comprising it, why does society tend to disappear as these individuals are remotely separated?

7. Show how an apple is a complex of simpler objects in relation, and yet is more than a mere "cluster" of present sensible qualities.

8. Describe recognitions of your own in which the consequent was (*a*) an act of naming, (*b*) a feeling, (*c*) a postural adjustment.

9. Describe and explain some "false recognition" in your experience, as in "recognizing" a place where you have never been before.

10. Examine the advertisements in a magazine, marking all those you have ever "seen before." In each case note how the recognition takes place, in what it consists, and what are the effective details.

CHAPTER IX

1. Describe some case in which you "thought of" things by using counters to represent them.

2. In playing such a game as chess or checkers, in just what way do you "think of" the various possible moves?

3. In what various ways might a carpenter "think of" the different possible floor plans of a house?

4. Some people "think" more freely when walking alone along a country road. What various explanations might be given?

5. How, for example, might the "prospectiveness" of the army officer's campaign be represented or "thought"?

6. Describe some case in which tonal relations (as of pitch, duration, sequence) are represented by space relations of visual objects or patterns.

7. Some people are said to become hoarse from listening intently to a public speaker. What explanations might be offered and what light thereby thrown on the occasional nature of thought?

8. "Think of" a number of friends you have not recently seen. In each case report carefully the form the thought takes, the material of which it is composed.

9. Make a collection of sentences found in your general reading, in which the word "meaning" occurs, and note which definitions of the word fit each case.

10. A man with a recently vaccinated arm found it painful to listen to an eloquent lecture on the heroism of Savonarola. Can you suggest plausible reasons for the pain?

CHAPTER X

1. With eyes closed, touch with the palm small surfaces of different visual spread or size. Which is more discriminative, vision or touch?

2. Close your eyes and draw circles as large as a dollar, a quarter, a dime, respectively. Now open your eyes and draw circles for each that look more nearly correct. Now compare the two sets of circles with the actual coins. Discuss your results.

3. With closed eyes, move the fingers one at a time, and move the forearm over short and long stretches. Carefully observe the kinæsthetic patterns in each case. Are they discriminable? How?

4. Note the "feelings" in the eyes when looking back and forth from your pencil to a distant object. Note the kinæsthesis in moving the eyes with lids closed. How do these patterns differ from the kinæsthesis of joint movements?

5. Note how far apart the points of a two-legged drawing compass must be to be felt as separate on fingertip, back of hand, and forearm. Can you offer any explanation of the results?

6. Point with your finger directly at the doorknob. Continuing to point, look first with one eye, then with the other. What do you observe? How do you explain it? Are you right-handed? Why?

7. Try the experiment on localization of sounds, on some one who sits blindfolded and points each time in the direction of the sound you make. Report results. Move about carefully. Why?

8. Look at a painted landscape now with one eye, now with both. Do you observe any change in the appearance of the landscape? What and why?

9. Describe some occasion when you mistook a small thing near by for a large thing far away. Why?

10. Can you suggest explanations for the Müller-Lyer illusion and the horizontal-vertical illusion? Do these fit the general laws of perception? Explain.

CHAPTER XI

1. Describe some case where your choice of friends was guided by trivial signs.

2. How can you explain the origin of many beliefs about weather signs, in terms of the redintegrative paradigm?

3. Try the social perception pictures on children of different ages and report your results, comparing them with those given in the text.

4. Describe your own mental processes in deciding "how the lady feels" in a picture. Note closely everything that occurs.

5. State some facial or bodily features that you have heard affirmed to be signs of character. How might such claims be tested?

6. Show how redintegration is responsible for popular character inferences from "the bull neck," "the feline tread," "the clammy hand," "the protruding jaw," "the eagle eye," "the shifty glance," "the fiery temper of the red-headed man."

7. By what precautions might the testimonial and the interview be made more reliable and informative?

8. It will be instructive for all members of the class to rate one another (including self) in various traits, by ranking all in an "order of merit," then studying the comparative and average judgments.

9. Why do children have such apparent difficulty in distinguishing between the real world and the world of fancy or fiction? How might they be assisted in this discrimination?

10. Show in the case of physics and chemistry the existence of the world of ideal construction.

CHAPTER XII

1. Describe some instance of code learning in your own experience, noting resemblances and differences when compared with the case described in the text.

2. Describe the detailed steps, as well as you can, of learning some motor coördination, such as knitting, riding a bicycle, skating.

3. Why is it difficult to learn a verse merely by looking at it, without actually saying it aloud or in silent speech?

4. Say the alphabet backward, noting the time required, and the various steps and devices, and the difficulties encountered.

5. If printed maze tests are available, accomplish one of them repeatedly, timing yourself and noting changes of method in successive trials.

6. Describe some case of animal learning you have observed. Explain it in the simplest possible terms. Why does science prefer the simplest modes of explanation?

7. Show how the development of a technique through history resembles the course of learning in the case of the individual.

8. What practical rules of reward and punishment follow from the "law of effect" as here stated?

9. What might be responsible for improvement in the left hand in sign painting, by practicing with the right hand?

10. What things might be learned in studying German that could conceivably be used to advantage in subsequently studying Latin? Mathematics? Cooking?

CHAPTER XIII

1. Cite any observations showing that the learning ability of the lower animals varies with age.

2. A question once much debated was whether quick learners are easy forgetters. Can you cite any evidence on this question? Just what is the relation between slowness of learning and retention?

3. Secure a blank for the code learning (Woodworth-Wells Substitution Test) and do the experiment on a child. Compare the time record with the standards given in the chapter. Watch the child as it progresses through the sheet, and report any observations.

4. Do you suppose that the inflexibility and conservatism of old age is merely a matter of greater difficulty of learning? Why?

5. Indicate various physical factors that influence learning rate.

6. If an advertiser is to mail a series of six sales letters, over a three-month period, to the same people, what mailing schedule would you recommend, and why?

7. Say the alphabet backward fifteen times, taking the time required on each occasion. Graph the time records to form a learning curve, and compare with those given in Figure 23.

8. Give various possible reasons for the value, for learning, of occasional attempts at recitation.

9. Criticize the forms of vividness used in current advertising, from the point of view of the experiment on verbal learning. What other considerations must, of course, be borne in mind?

10. Cite some observations of slow progress through being "wedded to a technique."

CHAPTER XIV

1. Try to remember the details of the last football game or tennis match you saw, noting the form in which such memories come to you.

2. Recall the front of the building you are now in, noting the way the various details are represented in thought. Describe them.

3. Try to recall exactly your road home, and write out a description of all that occurred in the process. Avoid the stimulus error.

4. Find some recent book on how to study and list all the rules there given for effectiveness of memory.

5. Describe some "absent-minded act" you have observed, and try to account for it psychologically.

6. Try to "locate" some past event accurately in your biography, and describe the way in which you did it. Describe, instead of interpreting.

7. Try the memory span experiment, on p. 266, on several friends, and compare the results with those cited in the text.

8. If there is some name that you have difficulty in recalling, write down consecutively all the names that come to you in making the attempt, until the correct one comes. Then study the series, noting how the correct pattern was gradually restored or reconstructed.

9. Read a page of a book one day. The next day try to write it out from memory. Try again in a week. Compare your reports with the original, noting any examples of the typical "qualitative" changes in forgetting.

10. It is sometimes maintained that "we forget the disagreeable." What evidence can you adduce for or against this generalization? If the statement requires qualification, how would you modify it?

CHAPTER XV

1. Try to imagine a totally new kind of human dwelling. Observe all that occurs to you and the form in which it is represented, or what it represents.

2. Devise some new symbol for each letter of the alphabet. Note how your mind works, what the difficulties are, and what light is thrown on the procedure of imagination.

3. Just what is meant by "The idea is old but the words are new"? How does this differ from the case where new ideas are expressed in familiar form? What are the "ideas" in such cases?

4. If you have had what you believe to be an "original idea," try to describe the way it evolved, and how you now entertain it.

5. Observe the sports of children, noting the proportion of times they start with "Now let's play that. . . ." At what age is this "play of pretense" most prominent. Do you do it, perhaps in reverie?

6. If you ever invented a device of any kind, describe the process of invention. If not, read the story of some invention and discover how it happened. Compare the account with that of the text.

7. Draw a picture of some animal of which you have never heard. Have several people do this and compare the products, as samples of imagination.

8. Show how, in one of your dreams, current stimuli and perseverating hopes, fears, or worries combined to produce the actual dream episode (the manifest content as it is sometimes called).

9. Note the image that comes during drowsiness and compare it with your ordinary imagery of waking life.

10. Try the word-building test yourself, and apply it to several others, including children. Compare the records with the age norms given on p. 296.

CHAPTER XVI

1. What are the "motives" in the case of a windmill; a growing plant; the movement of iron filings to a magnet?

2. What is the "motive" in the case of sneezing; in screaming with pain; in going to the dentist?

3. Describe some motivated act you have recently observed, noting the character of motive and act, and the way the latter affected the former.

4. Men once fought duels to "satisfy honor." Show the nature of this motive and show how it was alleviated by the duel.

5. It is sometimes said that "maternal love," when disappointed, may be satisfied through charity work, nursing, or art. Explain what really happens.

6. Show how football, preventive medicine, science, preaching, or politics may be alternative techniques for the alleviation of the same motive.

7. Describe a case where the motive to activity was an event within the organism; an event outside the organism.

8. Just how does a given motive become linked up with an array of techniques of solution? Is there more than one way? Describe.

9. Describe in detail some purpose of yours, distinguishing within it the motive and the plan or symbol.

10. Make up your mind to do something, but do not do it yet. In what form were "the thing intended" and the "resolution to do it" present at the moment of decision?

CHAPTERS XVII AND XVIII

1. Describe fully the act of going to sleep, showing its objective and subjective complexity.

2. During one minute write as many disconnected words as you can, taking whatever words "come to mind." Now study their succession, noting relations between adjacent words, and trying to explain the "order" of even such random thoughts.

3. It will be instructive to do some free and controlled association tests available in the laboratory, noting their character, use, and interpretation.

4. Tell some friend to make any arm movement in response to some movement you make. Try several movements, and several people. Note the relations between their movements and yours. Can you make any generalizations concerning "association of movements"?

5. Describe some case in which fixity of habit impeded progress.

6. Describe in your own case some habit (*a*) of acting, (*b*) of feeling, (*c*) of thinking, and (*d*) some habit clearly involving some combination of these.

7. Choose some lower animal and enumerate all the things it seems to do "instinctively." What are your criteria of "instinctive"?

8. Compare the "lists of human instincts" given in different books on psychology. What agreements and differences do you find? Why?

9. Describe some instance in human beings where two tendencies conflicted, giving a detailed picture of just what occurred. Keep your description separate from your interpretation. Why is this difficult?

10. Prepare a list of the chief or fundamental wants of mankind: (*a*) at birth, (*b*) in maturity, (*c*) in very old age. If there are changes, on what do they probably depend?

CHAPTER XIX

1. Produce various pains (on yourself) experimentally and try to describe, analyze, and classify them.

2. Catch yourself when "tired" and try to describe in detail the different factors involved in "the feeling of fatigue."

3. Place yourself in some situation which "bores" you and try to describe what this condition is, introspectively and objectively.

4. Cite examples showing the dependence of pleasantness and unpleasantness on bodily conditions; recent activity; past experience.

5. Catch yourself in a moment of "belief" or "doubt." Try to describe the experience and to analyze it into its possible components.

6. Think in succession such ideas as "however," "therefore," "but," "on the other hand," "obviously," "nevertheless," "surely"—noting the shifts of imagery, feeling and kinæsthesis. Describe the more striking observations. Which factors seem most important?

7. Draw up a list of "fundamental activities" and their parallel "fundamental feelings" (thus weeping—sadness, swearing—anger, etc.). How well can such a parallelism be established? Why?

8. Try to draw up a list of representative feelings arranged in pairs of opposites (as happy—sad). Do all the emotions have opposites? What other difficulties do you find?

9. Try to list all the situations in which you are (*a*) vexed, (*b*) amused, (*c*) proud. Can you generalize in the case of any of the lists, or are the situations unrelated?

10. Cite illustrations showing how emotions, once aroused, may survive their stimuli, and color subsequent events. Why or how?

CHAPTER XX

1. Put a small animal in a cage with open gate and note just how it finds its way out the first time. The second time. The third.

2. Hinge the gate to swing outward with slight pressure, and put the animal in again. Watch its mode of escape for several successive trials and report the process of problem solution.

3. Describe your attempt to handle some mechanical obstruction or difficulty, and compare your behavior with that of the cat in the cage. What resemblances and differences? Are there qualitative differences?

4. Higher monkeys, and gorillas, facing a problem, sometimes appear to hesitate, then suddenly solve the problem with little fumbling. In what various ways may such "insight" be explained? Which explanation do you prefer? Why?

5. Secure an unfamiliar mechanical puzzle (as putting together a lock, spring clothespin, electric bell, or toy puzzle). Solve it several times, after each writing out a full account of your method of attack, your activities, and experiences. What do you conclude?

6. There is only one other English word that can be made from the precise letters in the word "chesty." Find this word, meanwhile observing your method throughout. Write up a full report, comparing it with the analysis of reasoning given in the text.

7. Think out the following problem, noting carefully and descriptively the process of reasoning: "Why do men have buttons on their coat sleeves?"

8. Decide the following problem, reporting carefully the course and the materials of your reasoning. You are offered expenses and a good salary for one year to investigate any psychological topic you wish. What topic will you investigate?

9. Cite original examples of observation, judgment, inference, and belief, as defined in the next.

10. Read in some *Logic* the section on "Fallacies." Can you explain psychologically the cause of some of these typical fallacies?

CHAPTER XXI

1. Illustrate prepotency of stimuli in the case of an infant; in the case of some of the lower animals.

2. One can prevent sneezing by pressing the base of the upper lip firmly with the fingers. What general principle is illustrated?

3. Give an illustration, from motion pictures, of two stimuli jointly effective in accomplishing what one alone might fail to do.

4. As you pass people engaged in audible conversation, note the

topic (as sickness, sport, money, etc.) and note age, sex, and probable education of the speakers. After accumulating an array of cases, make a study of the "coerciveness of topics" as shown by overheard conversations.

5. Note carefully the usual order in which you read the pages of a newspaper. Get such data from several people. Do the pages have different attention values? Why? How do individuals vary?

6. Single out by attention some relatively faint voice in a chorus or instrument in an orchestra. How is it modified? What of the others?

7. Why is it customary to give a "ready" signal before the "go" signal, in a race. What is the most favorable interval between them?

8. Describe some specific performance in which the individual showed lack of sagacity; unusual sagacity.

9. Attend closely to some event, and describe carefully your objective behavior and the subjective changes.

10. Listen to the uniform beats of a metronome at different rates. Describe the mode and pattern of subjective accent and rhythm, and consider why they appear.

CHAPTER XXII

1. Extend the hand with fingers outspread. You cannot bend the little finger alone. Try repeatedly and persistently until you secure such voluntary control, and report the way and stages through which it developed.

2. Repeat Bair's experiment, either of moving both ears, or of moving them alternately. Report your degree of success and compare the process with that analyzed in the text.

3. Catch yourself at the moment of making a decision. What form does the decision take, and in what does it consist?

4. What do you suppose to be the origin of the "feeling of effort" on occasions of choice and decision?

5. When you "concentrate attention on yourself," what precisely do you do? Consider different occasions and compare them.

6. What are the chief causes of stage fright, and how may it best be avoided?

7. Note carefully what you do when you "listen" for something, and describe the process.

8. In what form do the various "considerations" present themselves when you are "making up your mind"? Report some actual observation.

9. If will is not a power or faculty, just how can one have a weak will? How does one acquire a strong will? Or is one born that way?

10. What precisely is meant by "breaking the will" of an animal, as when a horse is being "broken in"?

CHAPTER XXIII

1. With color mixer or color top, discover and formulate or illustrate the laws of color mixture and combination.
2. Place small rectangles of colored paper on larger rectangles of different colors, noting the relative pleasingness or harmony of different combinations. Can you formulate general rules?
3. Investigate the "color theories" proposed in books on physiology and optics, and state the chief rival theories.
4. Name, in turn, as rapidly as possible, each of the one hundred forms on the substitution sheet, p. 200, measuring the total time required. Divide by one hundred, thus securing the average time for a single act, thus an approximate discrimination time for five alternatives. Graph the records of all the members of the class in a surface of frequency.
5. Report the facts about color blindness found in books on physiological optics or physiology of the special senses.
6. Demonstrate Weber's Law in the case of lifted weights.
7. Learn from a book on physics the nature and physical conditions of noise, tone, beats, combination tones, overtones, consonance.
8. Have three vessels of water, one warm, one neutral, one cool. Place the two hands, one in the warm, the other in the cool. Then plunge them together, after a minute, into the neutral. Describe the results. How are such results to be explained? Do they happen in other senses?
9. Demonstrate the hot and cold spots on the skin as described in some textbook of physiology or the physiology of the senses. Are there also pain spots? How can you demonstrate them, if so?
10. Do tastes and odors neutralize one another and fuse with one another, and exhibit contrast, as colors do? Give examples.

CHAPTER XXIV

1. Explain just why health is not an elementary trait but a resultant.
2. Find, among a collection of mental tests, examples conforming neatly to the separate definitions of intelligence. Does the same one usually illustrate all the definitions?
3. Show in the case of some selected test how both learning and sagacity are involved in its performance.
4. Find some book giving tables of "mental norms" and become familiar with their character, derivation, and use.

5. Find tests illustrating each of the "methods of construction."

6. All members of the class may be measured by some group intelligence scale or test, as the Army Alpha, the Otis, or others.

7. Become acquainted with several "performance tests" or non-verbal tests, and consider their character and usefulness.

8. Read about "rating scales" in some volume on personnel methods or applied psychology. What is their nature, variety, and justification?

9. All members of the class may be given some character test, such as an interest analysis, an emotional stability inventory, a will profile test, or an introversion analysis. The scores may be studied, graphed in a surface of frequency, and correlated with the scores in the intelligence test.

10. It will be instructive to examine some feeble-minded individual with a number of different tests, or to make a psychographic analysis of some member of the class, using a variety of comparable measures. Might such analyses sometimes afford suggestions for vocational guidance?

APPENDIX III

SUGGESTIVE REFERENCES ON SUPPLEMENTARY AND RELATED TOPICS

CHAPTER I

Further illustrations of the nature of redintegrative sequences may be found in the following:

Hollingworth, H. L. *Psychology of Functional Neuroses* (Appleton). Chapters I-III give many examples in normal and abnormal conditions.

Russell, B. *The Analysis of Mind* (Macmillan). Chapters IV, V, XV adopt the concepts of Semon and describe mind as characterized by these "mnemic" or redintegrative sequences.

Semon, R. *The Mneme* (Macmillan), Chapters I, II, IV-VII. The laws of the "engram" and its "ecphory" are the neurological equivalents of the facts of redintegrative sequence as conceived in this book.

Smith, S., and Guthrie, E. *General Psychology in Terms of Behavior* (Appleton). Chapter III, on "Learning," gives many illustrations and applications of the redintegrative sort, called by them "conditioned responses."

Woodworth, R. S. *Psychology* (Holt), Chapter XVI. The "law of combination" as presented and illustrated is the law of redintegrative sequence. Woodworth is also interested in its neurological implications.

CHAPTER II

On the nature of subjective occurrences the following may be consulted and compared:

Bentley, M. *The Field of Psychology* (Appleton), Chapters I-III. The general point of view of a revised structuralism.

Hollingworth, H. L. *The Psychology of Thought* (Appleton), Chapter XII. Defends the concept of the "psychophysical continuum," objecting to the sharp distinction between subjective and objective facts.

JAMES, W. *Principles of Psychology* (Holt), Chapters VI, IX, X. Chapters on "The Mind Stuff Theory," "The Stream of Thought," and "The Consciousness of Self."

RUSSELL, B. *The Analysis of Mind* (Macmillan), Chapter I. Comments on recent theories of consciousness.

THORNDIKE, E. L. *Animal Intelligence* (Macmillan), Chapter I. Insists that there is no real discontinuity between consciousness and behavior.

TITCHENER, E. B. *Psychology of Feeling and Attention* (Macmillan) and *Experimental Psychology of the Thought Processes* (Macmillan). First three lectures of the first, and first two and last chapters of the latter present an illustration and defense of "sensationism" in psychology.

WASHBURN, M. F. *The Animal Mind* (Macmillan), Chapters I, II. The evidences of "mind" in the lower animals.

WUNDT, W. *Outlines of Psychology* (Engelman). Various sections, easily identifiable from the table of contents, present Wundt's account of the nature of "immediate experience."

CHAPTER III

The following present varying points of view with respect to the problems and methods of psychology, and their comparison may be instructive, if time permits:

CALKINS, M. W. *A First Book in Psychology* (Macmillan), Chapter I and Section I of Appendix. Presents psychology as the science of related selves.

JAMES, W. *Principles of Psychology* (Holt). An eclectic account of some of the methods and snares of psychology.

MCDOUGALL, W. *Outline of Psychology* (Scribner), Chapter I. A survey of various points of view and a defense of vitalism in psychology.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), pp. 1-31. Gives selected extracts from a large number of representative writers.

STOUT, G. F. *Analytic Psychology* (Sonnenschein), Introduction. Presents and discusses various hypotheses and conjectures of psychology, which is "the study of the development of mind."

TITCHENER, E. B. *Textbook of Psychology* (Macmillan), pp. 1-41. Psychology as the analysis of consciousness, on the basis of parallelism.

WATSON, J. B. *Psychology* (Lippincott), Chapters I, II. Presents the point of view of extreme behaviorism.

CHAPTER IV

Further illustrations of the general redintegrative laws are to be found in the following:

ALLPORT, F. H. *Social Psychology* (Houghton Mifflin), Chapter III. The processes there called "afferent and efferent modification" are relevant to the general topic.

HOLLINGWORTH, H. L. *Psychology of Functional Neuroses* (Appleton), Chapters VI-IX. Various observations relating to the typical neurotic picture and its modifications.

——— *The Psychology of Thought* (Appleton), Chapter VII. The concept is here applied to the explanation of dreams.

SEMON, R. *The Mneme* (Macmillan). Various chapters develop special or general laws of "mnemic causation" or "ecphory" of "engrams." Aside from the neurological implications, this is redintegration.

CHAPTER V

Summaries of the facts of conditioned reaction experiments are to be found in the following accessible sources:

BURNHAM, W. H. *The Normal Mind* (Appleton). Chapters II-VI and other sections discuss the bearing of conditioning on mental health, and give useful bibliographies.

CASON, H. "The Conditioned Reflex, etc.," *Psychological Bulletin*, August, 1925. A survey and digest of conditioned reflex literature, with discussion of some of the leading facts.

PERRIN, F. C. and KLEIN, D. *Psychology* (Holt), Chapter III. Pages 92-122 give a very interesting running review of the topic of conditioning.

WATSON, J. B. *Psychology* (Lippincott). Pages 28-38 give some of the significant facts about and uses of conditioned reflexes.

YERKES and MORGULIS. "The Method of Pavlow, etc.," *Psychological Bulletin*, August, 1909. A review of much of the literature on the Russian experiments on conditioned reflexes, up to the date of publication.

CHAPTER VI

Descriptions and studies of some of the subjective phenomena discussed in this chapter are to be found in the following:

BETTS, G. H. "Mental Imagery; Its Distribution and Function," *Teachers College Publications*, No. 26 (1909). Gives an account

of the various notions about the use of imagery, and reports experiments on this point.

Binet, A. *The Psychology of Reasoning* (Open Court). Chapter II gives a traditional account of images, and Chapter IV describes various hallucinations and illusions.

Calkins, M. W. *First Book in Psychology* (Macmillan). Chapter II gives a brief but vivid account of the nature of imagery.

Galton, F. *Inquiries into Human Faculty* (Macmillan). A classical account of imagery, synæsthesia, number forms, and other interesting topics.

Robinson, E. S. *Readings in General Psychology* (University of Chicago Press). Chapter XII gives a number of extracts from various authors on points related to this chapter.

Wells, F. L. *Mental Adjustments* (Appleton). Chapter IV gives an interesting account of the "continuity of emotion" and its shifts from one to another object, by the method of "siphoning of affect."

Wheeler, R. H. "The Synæsthesia of a Blind Subject," *University of Oregon Publications*, Vol. I, No. 5 (1920). Gives a good summary and bibliography of previous studies

CHAPTER VII

References on the psychology of language:

Allport, F. H. *Social Psychology* (Houghton Mifflin), Chapter VIII. A description of the development of language in the individual.

Huey, E. B. *The Psychology and Pedagogy of Reading* (Macmillan). Describes the processes involved in understanding printed signs, the optical activities of reading, and reviews the origin of graphic symbols.

Jespersen, O. *Language, Its Nature, Origin and Development* (Holt). The best single reference on language.

Judd, C. H. *Psychology* (Scribner), Chapter X. A psychological analysis of the characteristics and use of language.

Stout, G. F. *Manual of Psychology* (Hinds, Hayden & Eldredge). Chapter V of Book IV describes the use of language as a human instrument and reviews theories of the origin of speech.

CHAPTER VIII

On the general characteristics of perception:

Achilles, E. M. "Experimental Studies in Recall and Recognition," *Archives of Psychology*, No. 44 (1920). A quantitative study of several points and a comparison of recognition with recall.

HELMHOLTZ, H. *Physiological Optics* (The Optical Society of America), Part III, Chapter XXVI.

JAMES, W. *Principles of Psychology* (Holt), Chapters XIX, XXI.

McDOUGALL, W. *Outline of Psychology* (Scribner), Chapter VIII.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), pp. 239-258.

WOODS, E. L. "Experimental Analysis of Process of Recognizing," *American Journal of Psychology*, July, 1915. A qualitative study of the process, with a good review and comparison of theories.

CHAPTER IX

On meaning and the nature of ideas, see the following:

BINET, A. *The Psychology of Reasoning* (Open Court), Chapters I, II. Takes the old point of view that all "ideas" are "images."

HOLLINGWORTH, H. L. *The Psychology of Thought* (Appleton), Chapters XI, XII, XIV.

JAMES, W. *Principles of Psychology* (Holt), Chapter IX. Maintains that "thought is possible in any kind of material."

MOORE, T. V. "Image and Meaning in Memory and Perception," *Psychological Review Monograph*, Vol. XXVII, No. 2 (1919). Experimental studies of meaning and thought, with results opposed to sensationism.

TITCHENER, E. B. *Textbook of Psychology* (Macmillan), pp. 505-529; *Experimental Psychology of the Thought Processes* (Macmillan), Chapter I.

WASHBURN, M. F. *Movement and Mental Imagery* (Houghton Mifflin), Chapter X. A brief but excellent survey of the work on "imageless thought."

WATSON, J. B. *Psychology* (Lippincott), Chapter IX. Discusses explicit and implicit language habits, contending that all thoughts are movements, chiefly laryngeal, but including also neuromuscular acts of other sorts.

WOODWORTH, R. S. "A Revision of Imageless Thought," *Psychological Review*, Vol. XXII (1925), pp. 1-27.

CHAPTER X

Space perception and optical and other illusions:

JAMES, W. *Principles of Psychology* (Holt), Chapter XX.

LADD and WOODWORTH. *Physiological Psychology* (Scribner), Chapters IV, V.

LUCKIESH, M. *Visual Illusions and Their Application* (Van Nostrand).

MYERS, C. S. *Experimental Psychology* (Longmans), Chapters XX-XXII.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), pp. 258-287. Gives an interesting set of selected passages from various authors, and a well chosen group of optical illusions.

TITCHENER, E. B. *Textbook of Psychology* (Macmillan), pp. 305-347.

WASHBURN, M. F. *The Animal Mind* (Macmillan), Chapters VIII, IX. Discussion of experiments on space perception in the lower animals, with summary of outstanding results.

CHAPTER XI

Social perception, character judgments, and the world as ideal construction, are discussed in the following, as indicated:

ALLPORT, F. H. *Social Psychology* (Houghton Mifflin), Chapter IX. An excellent discussion on the language of the face, emotional expression, and the interpretation of facial and bodily signs.

GATES, G. S. "Experimental Study of Growth of Social Perception," *Journal of Educational Psychology*, November, 1923; and "A Preliminary Study of a Test for Social Perception," *ibid.*, October, 1925. A study of the interpretation of facial expression, by children of varying age, tentative age and grade norms, and correlations with various other measures, using the photographs reproduced in this text.

HOLLINGWORTH, H. L. *Judging Human Character* (Appleton). A survey of the traditional methods, with suggestions for their improvement, reports of experiments, and descriptions of the development of more scientific methods of diagnosis and measurement of personal traits.

JAMES, W. *Principles of Psychology* (Holt), Chapter XXVIII. Includes, with numerous general scientific reflections, some account of the "world of ideal construction."

STOUT, G. F. *Manual of Psychology* (Hinds, Noble, Eldredge), Book IV, Chapters VI, VII. Chapters on the external world and the self as products of social and ideal construction.

CHAPTER XII

References chiefly on qualitative aspects of learning:

COLVIN, C. C. *The Learning Process* (Macmillan). A systematic textbook, focusing on learning, with educational applications.

GATES, A. I. *Psychology for Students of Education* (Macmillan). Chapters X-XIII inclusive give a very clear and readable summary.

KOFFKA, K. *The Growth of the Mind* (Harcourt, Brace). Various sections of the book present a criticism of the "connection forming" concept of learning, from the point of view of the *gestalt* psychology.

PYLE, W. H. *The Psychology of Learning* (Warwick and York). A useful volume, which attempts "to state everything that is known about learning."

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), Chapter V. Selections from various authors, under the title "Habit," dealing essentially with the problems of learning.

STARCH, D. *Educational Psychology* (Macmillan), Part II. Summary chapters on the general psychology of learning, giving experimental data.

THORNDIKE, E. L. *Educational Psychology: Briefer Course* (Teachers College), Part II. A classical analysis of the nature, conditions, rate, permanence, and transfer of improvement.

CHAPTER XIII

The following give general summaries or special reports of experimental studies of learning, of the quantitative sort, usually also with general principles and analysis:

BOOK, W. F. *The Psychology of Skill* (University of Montana Publications). Reports a study of the learning of typewriting.

BRYAN, W. L. and HARTER. "Studies in the Telegraphic Language," *Psychological Review*, Vol. VI (1899). A classical study of the curve of learning, and a discussion of the hierarchy of habits in such a process.

EBBINGHAUS, H. *Memory* (Teachers College Reprints). The classical study of verbal learning, by the quantitative method.

LADD, G. T. and WOODWORTH, R. S. *Physiological Psychology* (Scribner). May be used for summary of general results, and for comparison of the learning curves of men and animals.

PYLE, W. H. *The Psychology of Learning* (Warwick and York). The best recent summary, giving well organized chapters, many tables and graphs, and bibliography on separate topics.

THORNDIKE, E. L. *Educational Psychology*, Vol. II (Teachers College). An elaborate analysis with summary of quantitative results up to 1913.

CHAPTER XIV

On various aspects of memory the following will be useful:

BENTLEY, M. *The Field of Psychology* (Appleton). Chapter X gives a good general survey of the field, emphasizing also the structural introspective features of memory.

CROSLAND, H. R. "Qualitative Analysis of Process of Forgetting," *Psychological Review Monograph,* Vol. XXIX, No. 130, Part 1 (1921). Summarizes previous studies and presents new results on this topic.

EBBINGHAUS, H. *Memory* (Teachers College, Reprints). A classical experimental study of verbal learning (nonsense syllables) which was the stimulus for much later work in this field.

HOLLINGWORTH, H. L. "Experimental Studies in Judgment," *Archives of Psychology,* No. 29. Chapter IV gives a more detailed account of the "generalizing" central tendency of memory.

MYERS, C. S. *Experimental Psychology* (Longmans). Chapters XII and XIII give a good summary of many of the quantitative studies of memory.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), Chapter XIII. Selections from representative sources on general problems of memory.

TITCHENER, E. B. *Textbook of Psychology* (Macmillan), pp. 396-428. Gives an account of memory from the introspective point of view, an analysis of the "memory consciousness."

WATT, H. *Economy and Training of Memory* (Longmans, Green). A brief and clearly written account of the best rules and practice for effective use of memory.

WHIPPLE, G. M. *Manual of Mental and Physical Tests* (Warwick and York). A standard volume (Part II) giving various standard tests for the measurement of differences in memory, and affording tables of norms.

CHAPTER XV

Imagination, dream, and invention:

BENTLEY, M. *The Field of Psychology* (Appleton), Chapter XI. A more recent general survey of the topic of imagination.

HOLLINGWORTH, H. L. *Mental Growth and Decline* (Appleton). Chapter X, on "The Questioning Age," gives some attention to the imagination, make-believe, and dreams of children, and their place in mental development.

HOLLINGWORTH, H. L. *The Psychology of Thought* (Appleton). Chapters II-X inclusive survey the topics of sleep, drowsiness, and dreaming, with special reference to their bearing on thinking.

JAMES, W. *Principles of Psychology* (Holt), Chapter XVIII. An old chapter, well worth preserving, on imagination as "imagery." Reviews also the work of Galton and others, including Fechner and Stricker. Dwells also on "imagery types" and the neural basis of images.

RIBOT, T. A. *Essay on the Creative Imagination* (Open Court). A classical volume on the topic of its title.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), Chapter XIV. Varied selections from different authors, on imagination and dreaming.

ROYCE, J. "The Psychology of Invention," *Psychological Review*, Vol. V (1898), pp. 113-144.

TAUSSIG, F. W. *Inventors and Money-Makers* (Macmillan).

WHIPPLE, G. M. *Manual of Mental and Physical Tests* (Warwick and York), Vol. II. For various tests suggested for measuring differences in imagination and inventive fertility.

WOODWORTH, R. S. *Psychology* (Holt). Chapter XIX is an interesting discussion of imagination in play, worry, dream, and invention.

CHAPTER XVI

On motivation and human motives:

ALLPORT, F. H. *Social Psychology* (Houghton Mifflin), Chapters X - XIV inclusive present suggestive discussion of the play of human motives in social life.

KEMPF, E. J. *The Autonomic Functions and the Personality* (Nervous and Mental Disease Publishing Co.). A general and somewhat speculative but extremely suggestive account of cravings and emotions as visceral tensions.

McDOUGALL, W. *Social Psychology* (Luce). This volume is a detailed defense of the doctrine that the "instincts" are the "prime movers" of all human activity and the foundation of social life.

MOORE, T. V. *Dynamic Psychology* (Lippincott). Various chapters give an interesting picture of the sources and warping of human motivation, and the place of motives in social adjustment and mental hygiene.

THOMSON, M. K. *The Springs of Human Action* (Appleton). A comprehensive and systematic account of human motives, emphasizing especially the analysis of complex motives into simpler drives.

Woodworth, R. S. *Dynamic Psychology* (Columbia University Press). A short volume presenting the general point of view of drive and mechanism in human activity.

CHAPTERS XVII, XVIII

On reflexes, habits, instincts, and "association":

Allport, F. H. *Social Psychology* (Houghton Mifflin). Chapter III gives an account of "fundamental activities" more consonant with the point of view of the present text.

Bernard, L. L. *Instinct: A Study in Social Psychology* (Holt). This volume presents a critical survey of various points of view with respect to the nature and rôle of instincts.

Hollingworth, H. L. *Mental Growth and Decline* (Appleton). Chapters XIII and XVI give a developmental account of the more conventional modes of human behavior.

James, W. *Principles of Psychology* (Holt), Chapter IV on "Habit," and Chapter XXIV on "Instinct." Chapter XIV reviews the older theories of "association" of ideas and the supposed neural correlates of this process.

McDougall, W. *Outline of Psychology* (Scribner). Chapter V on "The Instincts of the Mammals and of Man" gives a characteristic account of the viewpoint of this author. Earlier chapters also give a general defense of the "hormic" psychology.

Robinson, E. S. *Readings in General Psychology* (University of Chicago Press), Chapters IV, V. A great variety of selections from different authors on reflex action, habit, and instinct.

Sherrington, C. S. *The Integrative Action of the Nervous System* (Yale University Press). An elaborate and influential analysis of the mutual relations of the reflexes, and of nervous integration and organization of pathways.

Titchener, E. B. *Textbook of Psychology* (Macmillan), pp. 374–396. Here is given a brief and critical statement of the doctrines of association, the conditions of associative tendency, and the associative consciousness.

CHAPTER XIX

Craving, feeling, and emotion:

Allport, F. H. *Social Psychology* (Houghton Mifflin). Chapter IV gives a very instructive account of feeling and emotion, with new suggestions concerning their bodily correlates and conditions.

Bentley, M. *The Field of Psychology* (Appleton), Chapter XIII. A good general survey of the topic of feeling and emotion.

CANNON, W. B. *Bodily Changes in Pain, Hunger, Fear and Rage* (Appleton). This book gives an important and graphic account of the effect of emotion on glandular and related activities, and of the reciprocal effect of glandular products on emotional status.

DUNLAP, K. *Elements of Scientific Psychology* (Mosby), Chapter XV on "Affective Experience" is particularly clear, and consonant with the present text.

JAMES, W. *Principles of Psychology* (Holt). Chapter XXV gives an account of "The Emotions" which in its time was revolutionary and which is still the most influential chapter on the topic.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), Chapters XVII, XVIII. Numerous selections from various authors.

WATSON, J. B. *Psychology* (Lippincott). Chapter VI presents interesting observations on the emotions of infants, their transfer and consolidation, and a behavioristic account of emotion as a topic.

WUNDT, W. *Outlines of Psychology* (Engelman), Sections 7, 12, 13 give typical "structuralist" accounts of the elements and complexes of feeling. Its interest is chiefly historical and comparative.

CHAPTER XX

On reasoning:

BENTLEY, M. *The Field of Psychology* (Appleton), Chapter XV. General account.

BINET, A. *The Psychology of Reasoning* (Open Court). An attempt to show that all reasoning is the "association of images," after the manner of the classical "associationist" school.

DEWEY, J. *How We Think* (Heath). A famous analysis of the procedure of reflection, with special emphasis on its pedagogical applications.

HOLLINGWORTH, H. L. *The Psychology of Thought* (Appleton). Chapters I, X, XI, XV, XVI develop more elaborately the general point of view presented in this text.

PILLSBURY, W. B. *The Psychology of Reasoning* (Appleton). A rather formal account of the thought processes, in which psychological and logical accounts are jointly considered.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), Chapter XVI. Selections from various authors, on different aspects of thinking.

TITCHENER, E. B. *The Experimental Psychology of the Thought Processes* (Macmillan). A short survey of experimental studies (chiefly German) of the thought processes, and a criticism of the

"pure thought" doctrines, from the point of view of a revised "sensationism."

CHAPTER XXI

The psychology of attention:

Hollingworth, H. L. *Advertising and Selling* (Appleton). Chapters IV-VIII give an elementary account, with illustrations, of the rôle of attention in commercial publicity.

James, W. *Principles of Psychology* (Holt), Chapter XI. A general chapter on attention, emphasizing its "accommodatory" aspects.

Pillsbury, W. B. *The Psychology of Attention* (Macmillan). At the time of its publication the most complete survey of the subject, and still one of the best single references.

Poffenberger, A. T. *Psychology in Advertising* (Shaw). Chapters VII-XI give a useful summary of the applied aspects of attention in human engineering.

Robinson, E. S. *Readings in General Psychology* (University of Chicago Press), Chapter X. Selections on the subject of "Attention" from numerous authors.

Titchener, E. B. *Textbook of Psychology* (Macmillan), pp. 265-303. A very clear account of attention from the structuralist point of view, with particularly good comparisons of the various "kinds" of attention—primary, secondary, and derived.

——— *The Elementary Psychology of Feeling and Attention* (Macmillan). A series of lectures, the last four presenting the laws of attention and the concept of attention as "sensory clearness."

Washburn, M. F. *The Animal Mind* (Macmillan), Chapter XII. A good brief account of the phenomena of attention and prepotent stimuli in the lower animals.

CHAPTER XXII

Voluntary action, decision, and choice:

Bentley, M. *The Field of Psychology* (Appleton), Chapter XII. A suggestive general survey of the topics.

Hollingworth, H. L. *Mental Growth and Decline* (Appleton), Chapters VIII, IX. On motor equipment at birth, and the development of activity organization and control in infancy.

James, W. *Principles of Psychology* (Holt), Chapter XXVI. A famous and stimulating chapter on the nature and cues of voluntary control, the types of decision, and the impulsive character of mental activities.

LADD, G. T., and WOODWORTH, R. S. *Physiological Psychology* (Scribner), Part II, Chapter VI. Gives a general account, quoting data, of the various reaction time experiments, and their interpretation.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), Chapter XIX. A number of representative selections from different authors, on "The Control of Action."

TITCHENER, E. B. *Textbook of Psychology* (Macmillan), pp. 428-471. A useful general chapter on the reaction experiments, and the genetic features of action.

WUNDT, WILLIAM. *Outlines of Psychology* (Engelman), Section 14. A typical "structuralist" account of the characteristics of volitional experience.

CHAPTER XXIII

On the sensory qualities, their laws and relations:

GORDON, K. *Esthetics* (Holt). A standard reference on the æsthetic feeling tone of sensory and perceptual materials and patterns.

HOWELL, W. H. *Textbook of Physiology* (Saunders). Section II is devoted entirely to the consideration of the physiology of the special senses.

LADD and WOODWORTH. *Physiological Psychology* (Scribner), Part II, Chapters I-V. A systematic account of the facts of sensation, qualitative and quantitative phenomena, and neural correlates, stimulus, sense organ, and discrimination.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), Chapters VI-IX. Many selected references from various sources on general aspects of sensation and the phenomena of the special sense fields.

TITCHENER, E. B. *Textbook of Psychology* (Macmillan), pp. 46-225. A good general survey of the facts and phenomena of sensation.

A number of special books on particular senses, notably on vision, hearing, taste, will be found in many libraries.

CHAPTER XXIV

Intelligence, personality, character, temperament:

ALLPORT, F. H. *Social Psychology* (Houghton Mifflin), Chapters V, VI. The best brief chapters on the constitution and measurement of the various features of personality.

HOLLINGWORTH, H. L. *Judging Human Character* (Appleton). A survey of traditional and modern scientific methods of appraising

human trait and aptitude, with description and illustration of the various test methods, rating scales, inventories, etc.

HOLLINGWORTH, H. L. *Vocational Psychology* (Appleton). A survey of the problems and methods of adapting individuals vocationally in terms of their personal traits, aptitudes, and attitudes.

HOLLINGWORTH, L. S. *Gifted Children* (Macmillan). A survey of the characteristics and implications for social life of intellectually gifted individuals, with many experimental and comparative results, and photographs, including bibliography to date.

——— *Psychology of Subnormal Children* (Macmillan). A general and descriptive account of the psychological pictures presented by the feeble-minded, and the problems involved in their social and educational treatment.

PINTNER, R. *Intelligence Testing, Methods and Results* (Macmillan). The best single brief reference on the history and method of intelligence measurement, the nature of intelligence, the various scales, with thirteen chapters summarizing the results in various fields.

PINTNER and PATERSON. *Scale of Performance Tests* (Appleton). A useful and interesting volume describing various non-verbal tests, and giving age norms of performance, instructions, and photographs.

ROBINSON, E. S. *Readings in General Psychology* (University of Chicago Press), Chapter XX. Selected citations from many authors on the general psychology of personality.

TERMAN, L. M. *The Measurement of Intelligence* (Houghton Mifflin). The standard handbook and text for use in connection with the Stanford Revision of the Binet Scale.

THORNDIKE, E. L. *The Measurement of Intelligence* (Teachers College). One of the most recent and empirical analysis of the technical problems, qualitative and quantitative, involved in the measurement of "intellect." Too difficult for the introductory student.

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